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Nakamura

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(54) **CONNECTOR**

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(73) Assignee: **Sumitomo Wiring Systems, Ltd.** (JP)

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May 20, 2010 (JP) 2010-116076
May 20, 2010 (JP) 2010-116077

(51) **Int. Cl.**
H01R 13/436 (2006.01)

(52) **U.S. Cl.** **439/752**

(58) **Field of Classification Search** 439/752, 439/595

See application file for complete search history.

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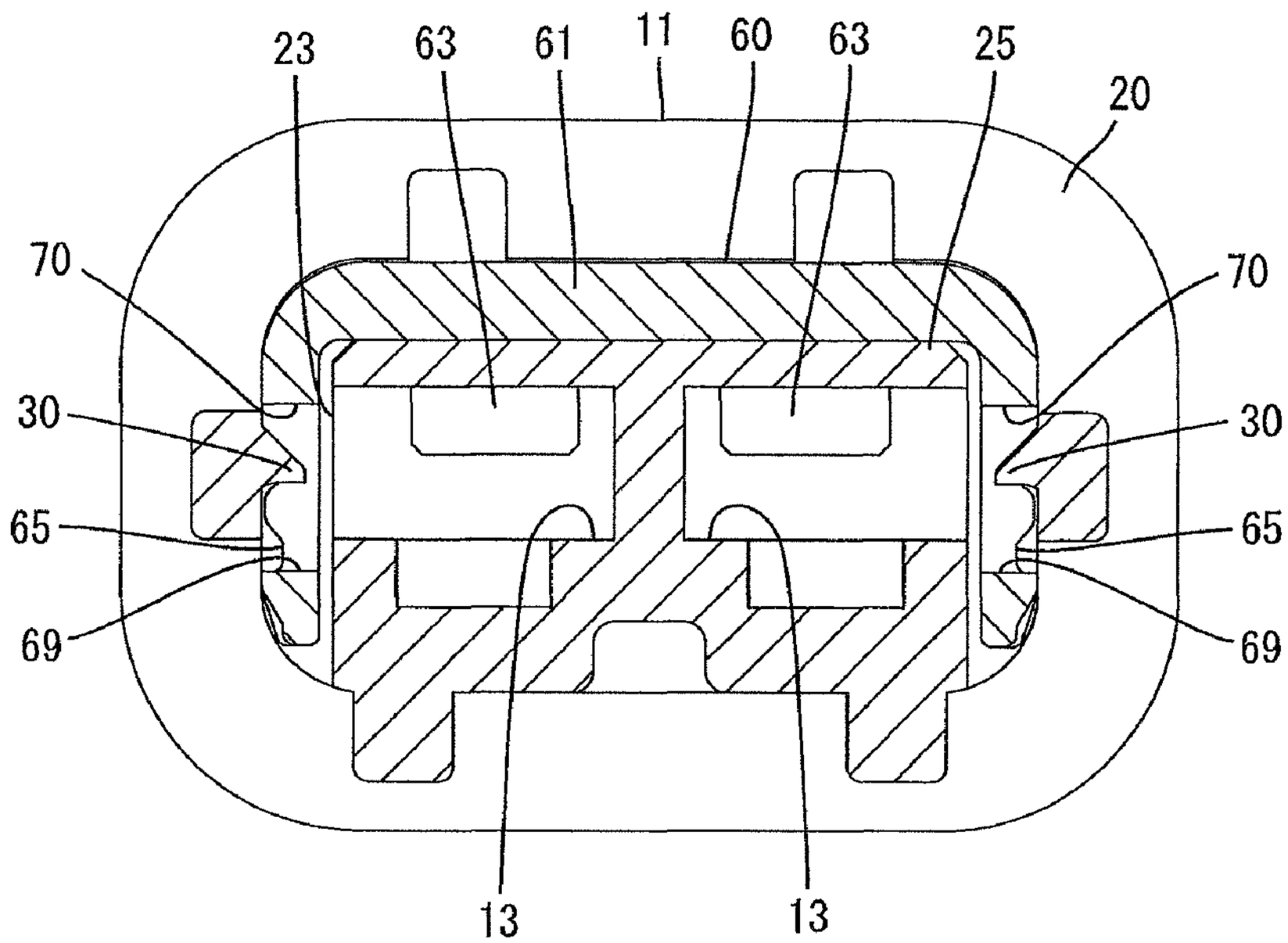
(57) **ABSTRACT**

A locking projection (**29**) of a housing (**10**) fits in a temporary locking concavity (**65**) of a retainer (**60**) to hold the retainer (**60**) at a temporary locking position and fits in a main locking concavity (**64**) to hold the retainer (**60**) at a main locking position. The main locking concavity (**64**) has a first slope (**67**) on a forward surface in a direction in which the retainer (**60**) is drawn out. The temporary locking concavity (**65**) has a first locking surface (**69**) on a forward surface and aligned orthogonal to the direction in which retainer (**60**) is drawn out. The locking projection (**29**) has a second slope (**35**) aligned along a surface of the first slope (**67**) at the main locking position and has a second locking surface (**33**) disposed along a surface direction of the first locking surface (**69**) at the temporary locking position.

10 Claims, 24 Drawing Sheets



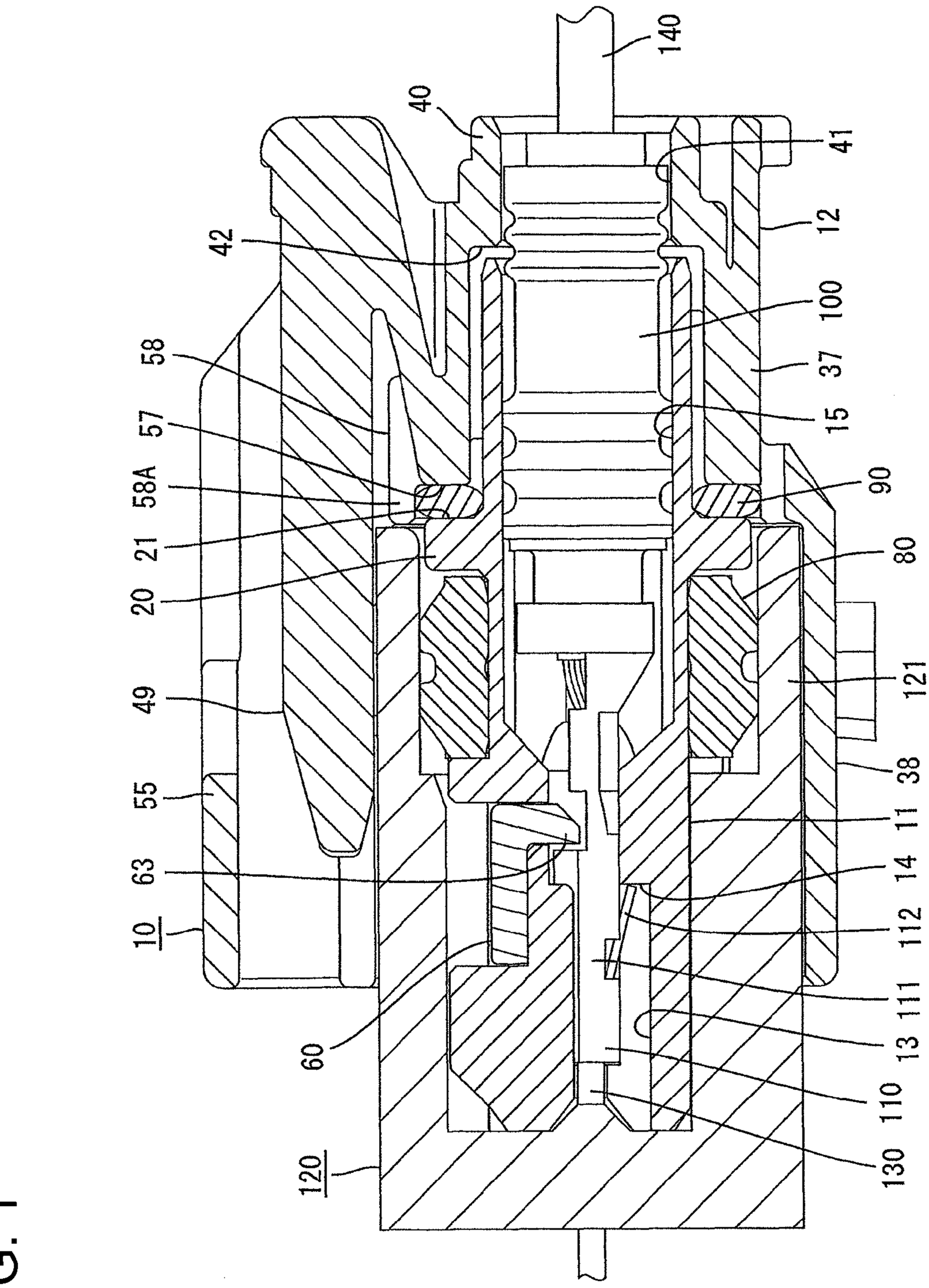

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FIG. 1

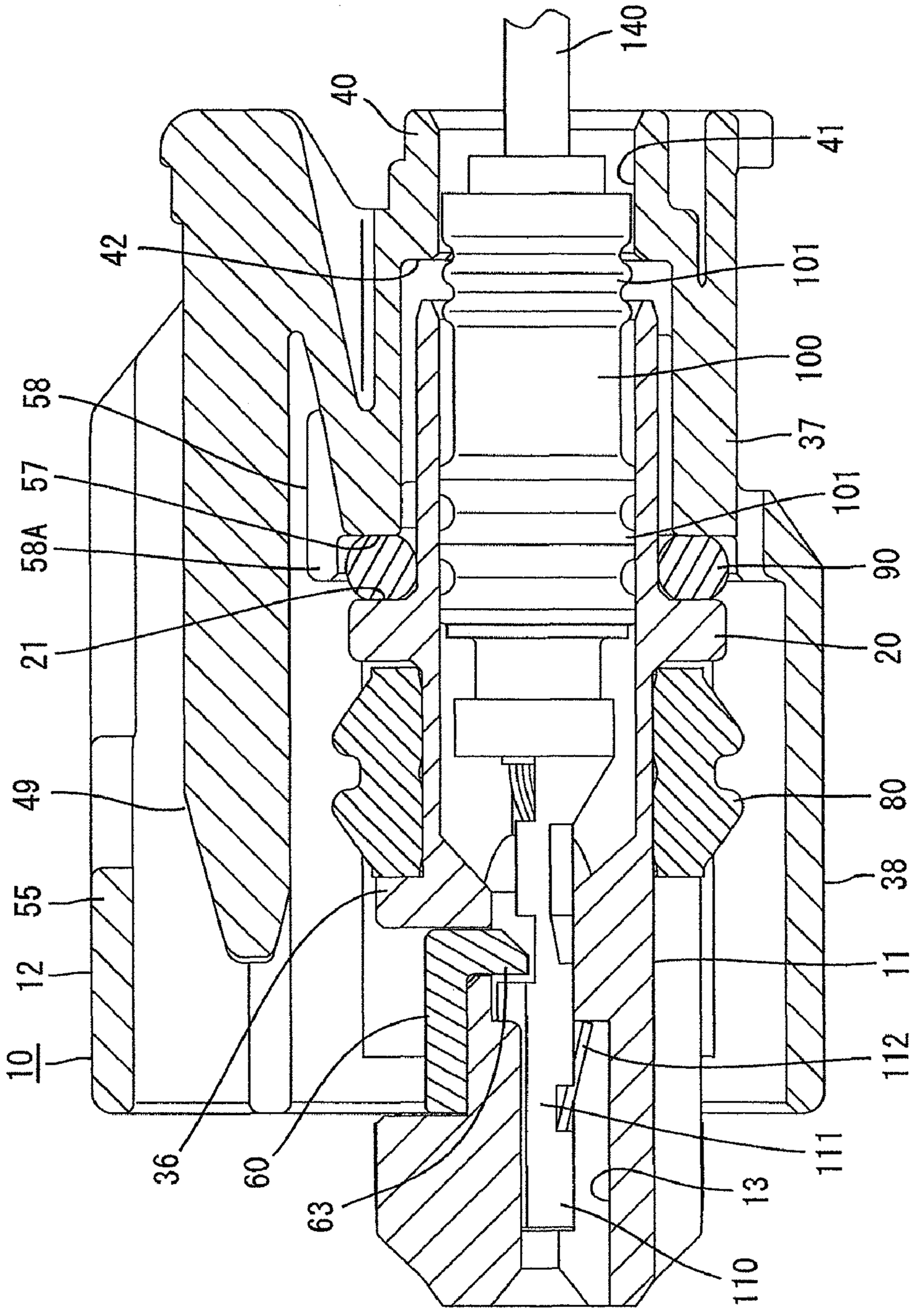
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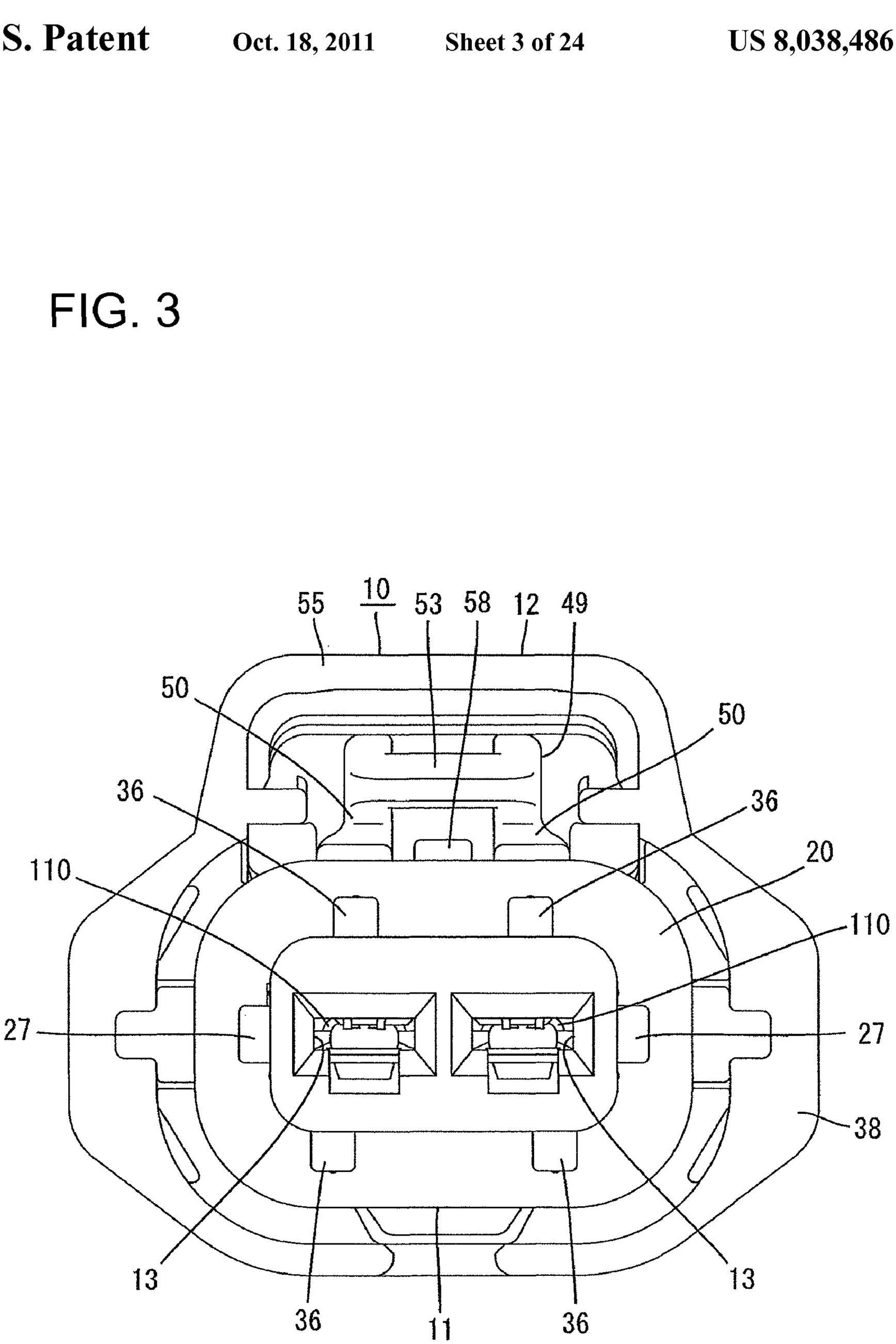
FIG. 2

FIG. 3



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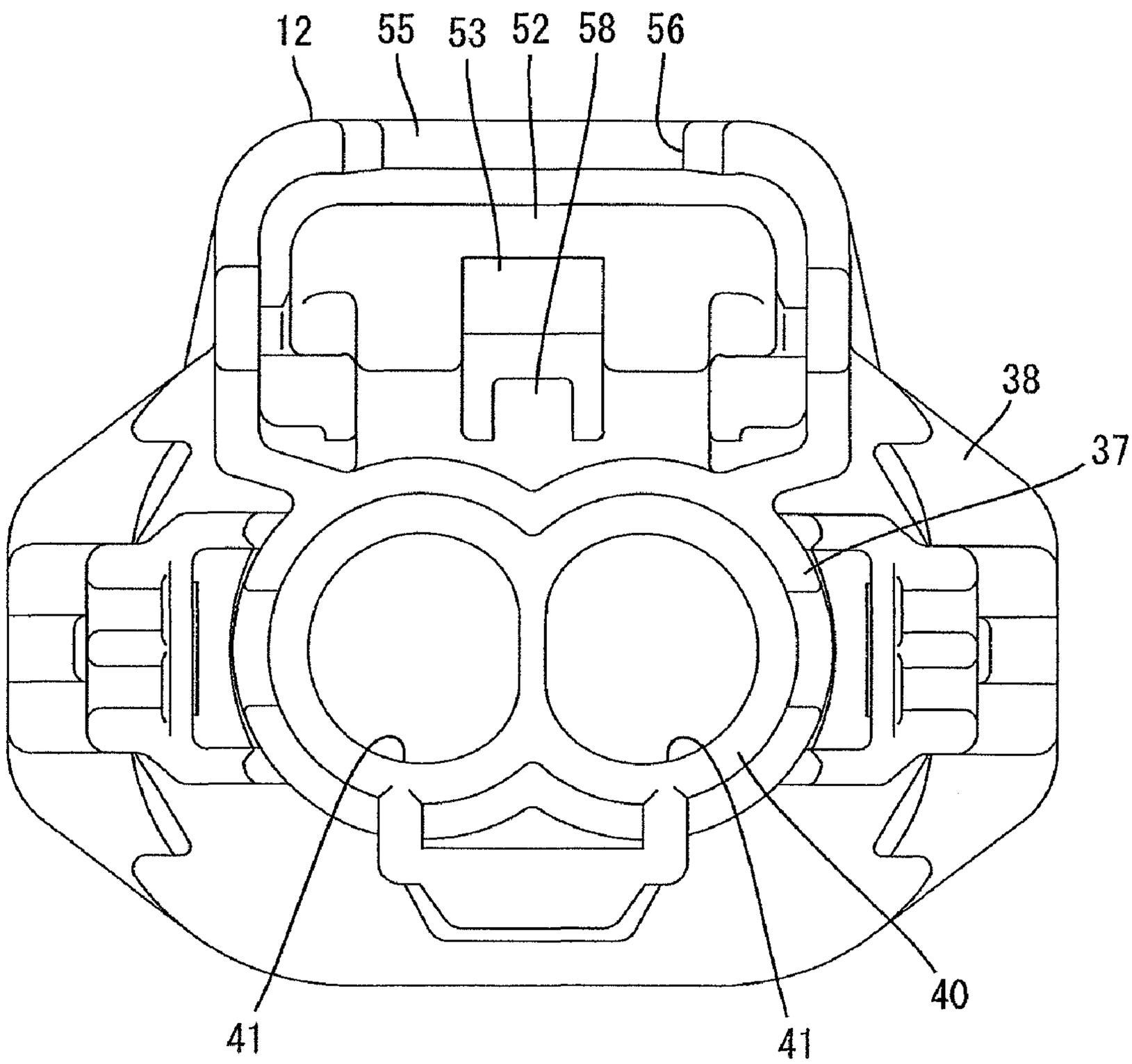
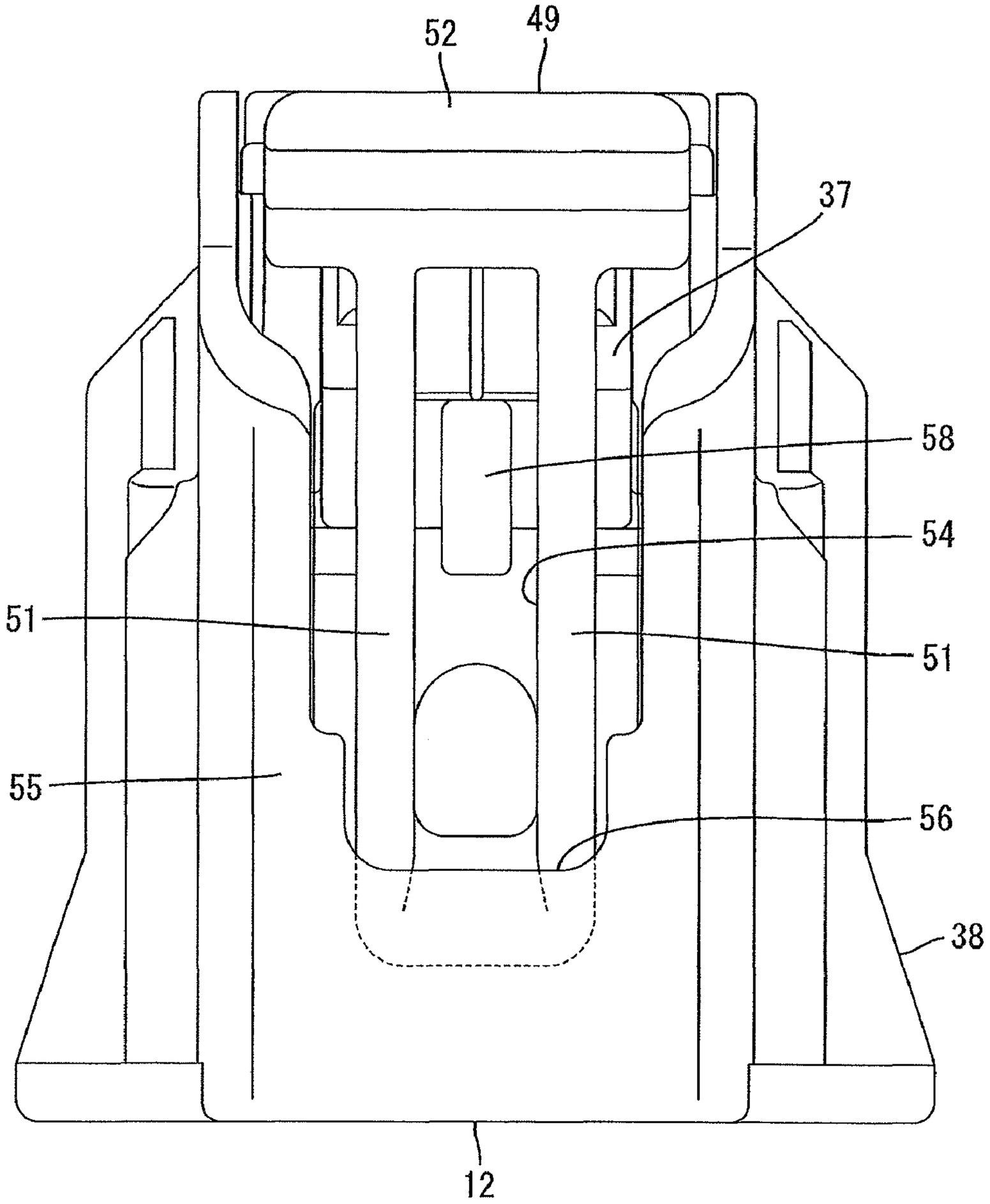


FIG. 5



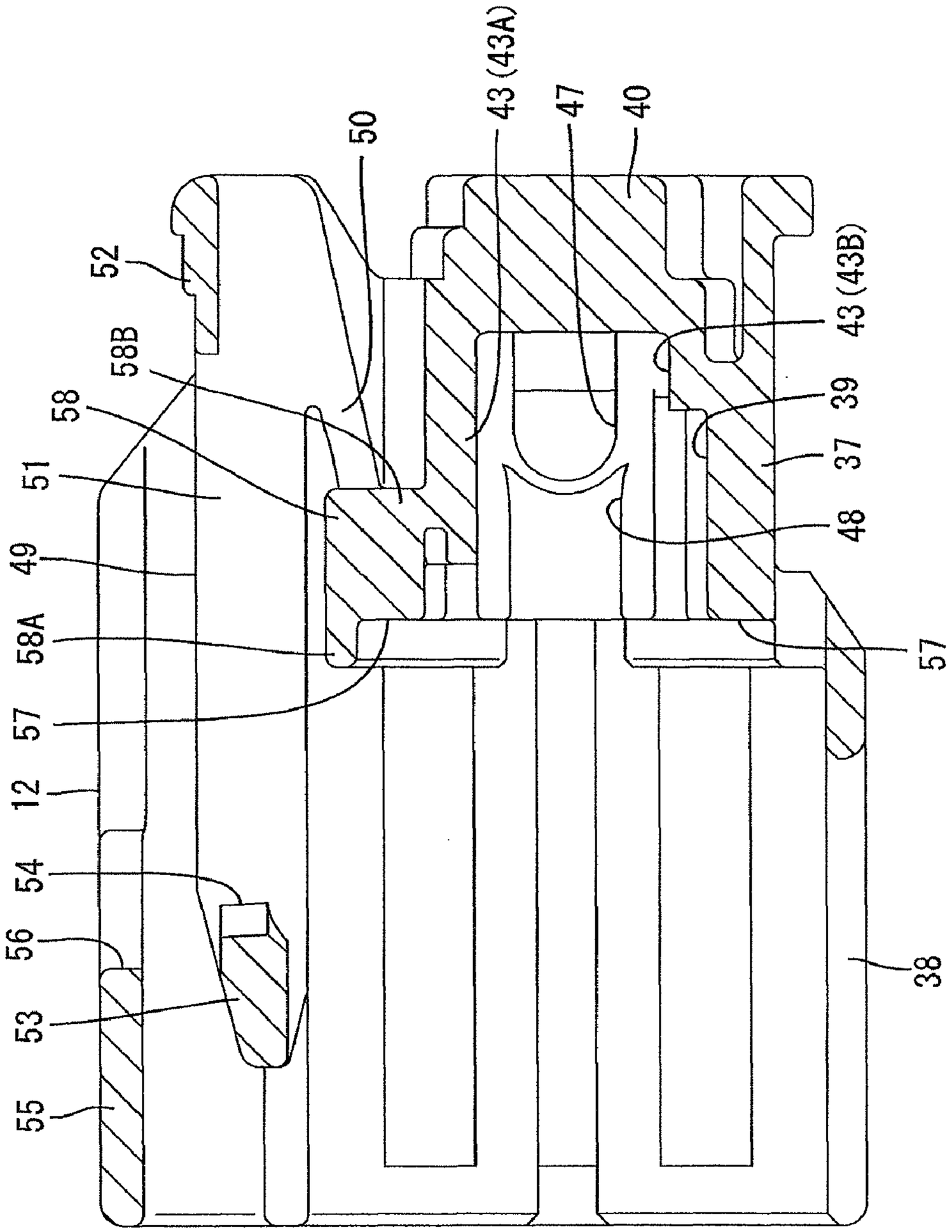

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FIG. 6

FIG. 7

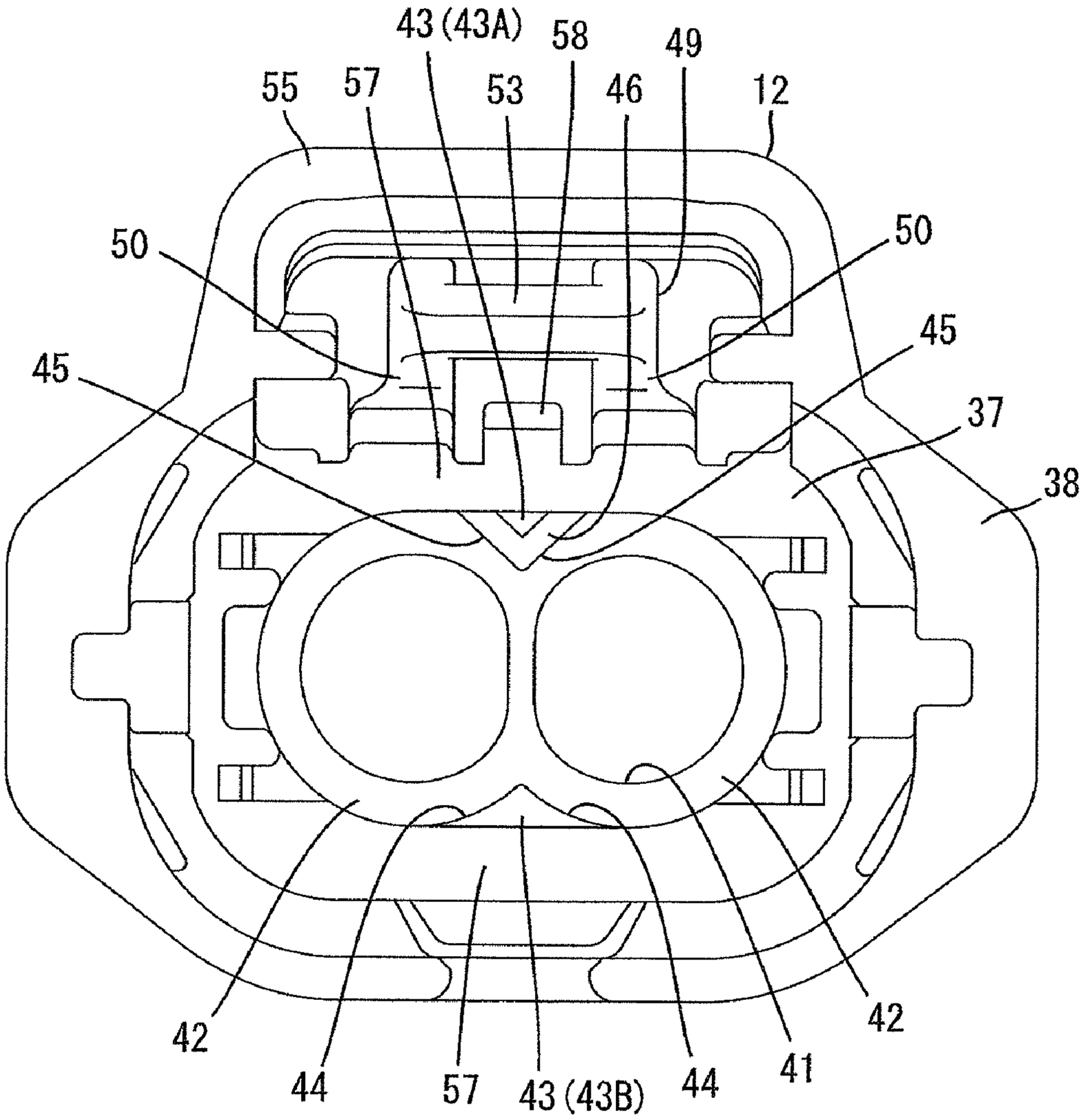

FIG. 8

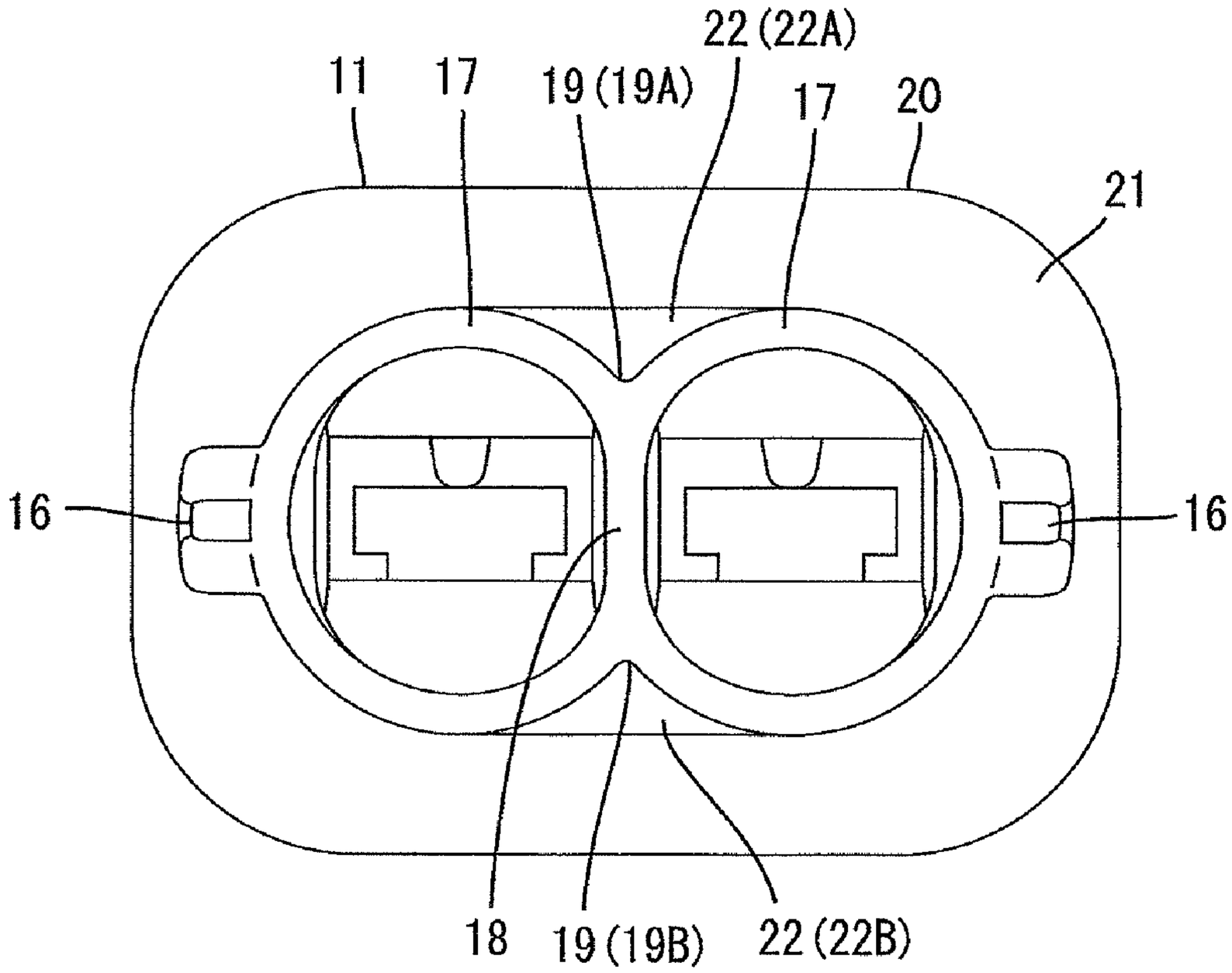

FIG. 9

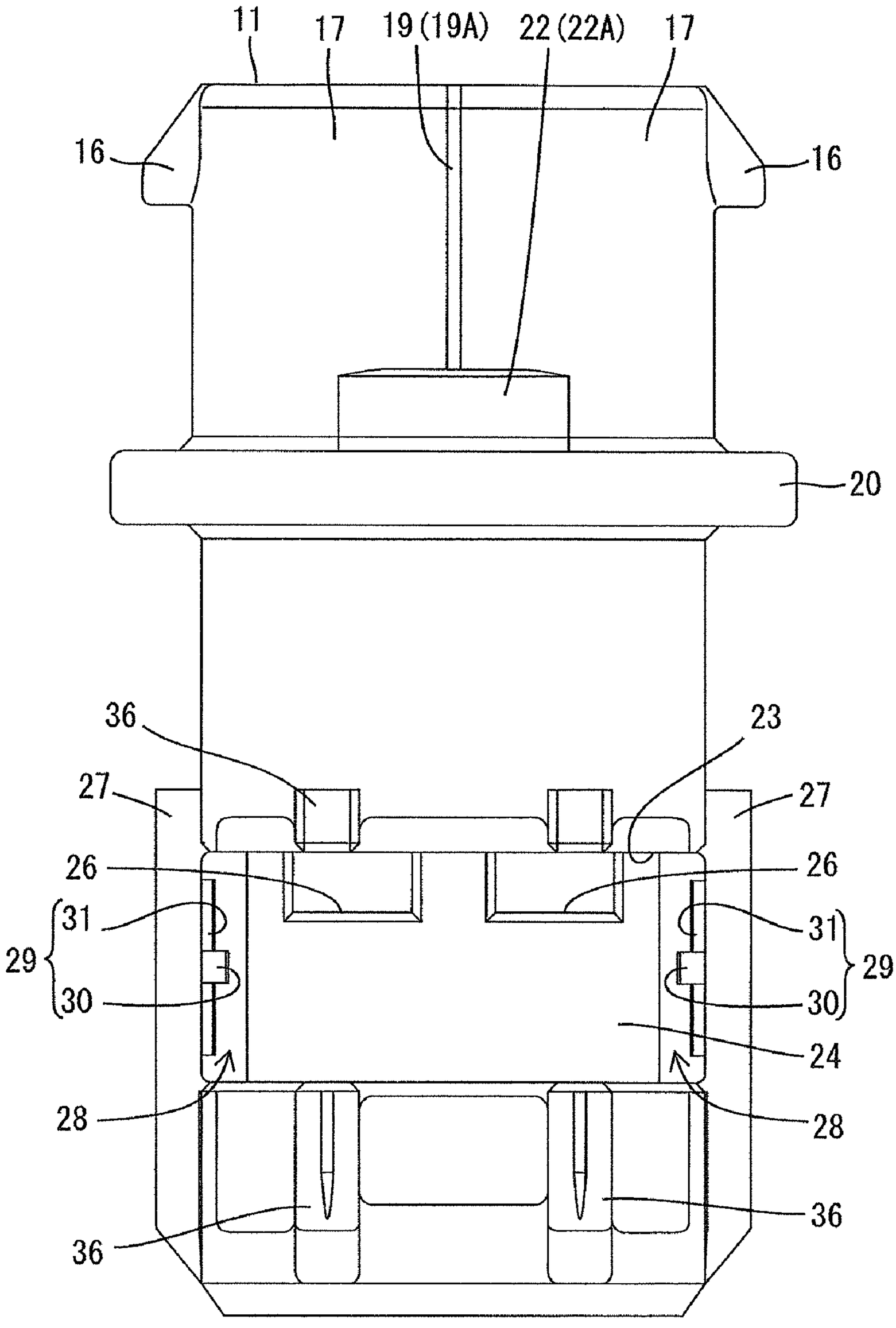
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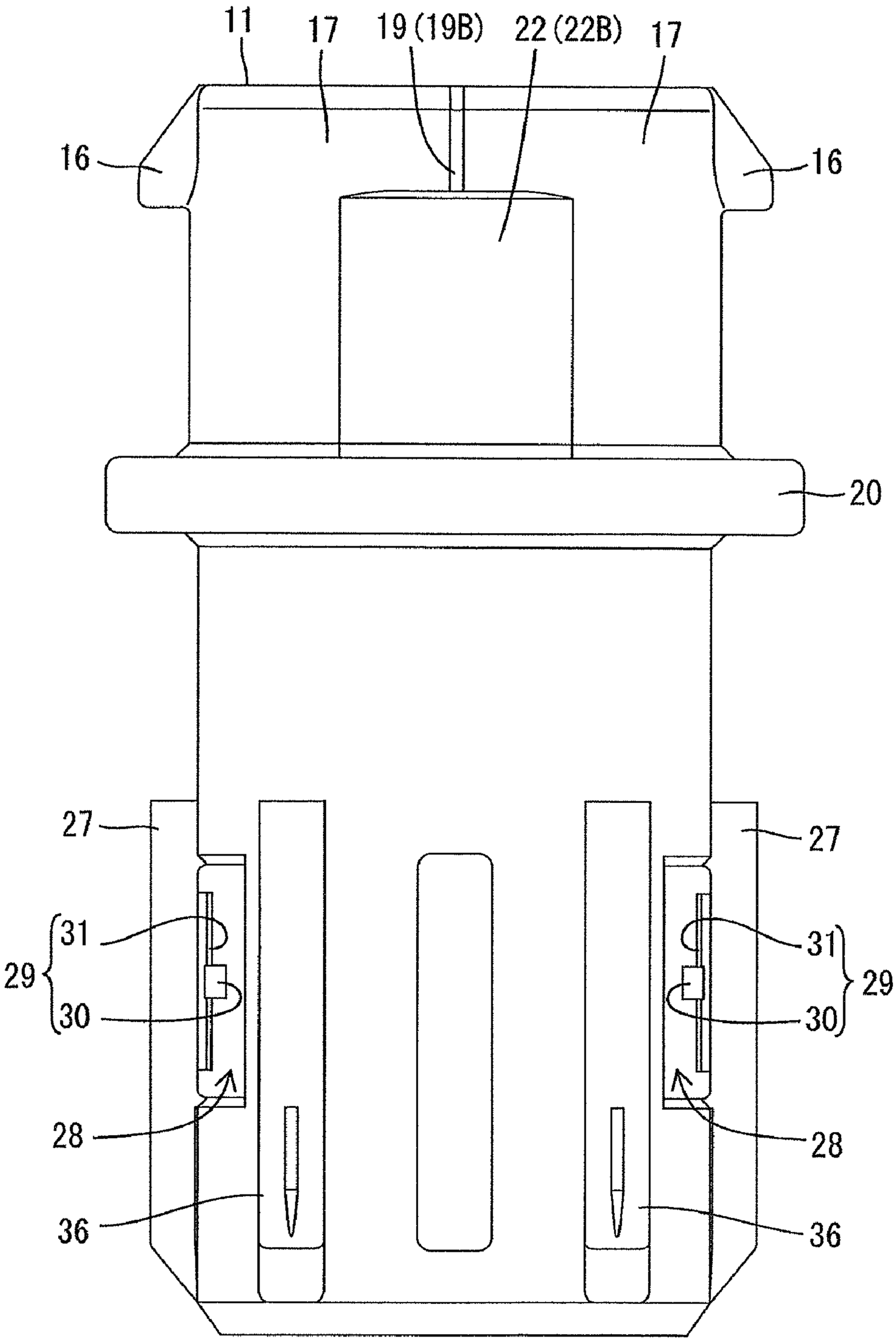
FIG. 10



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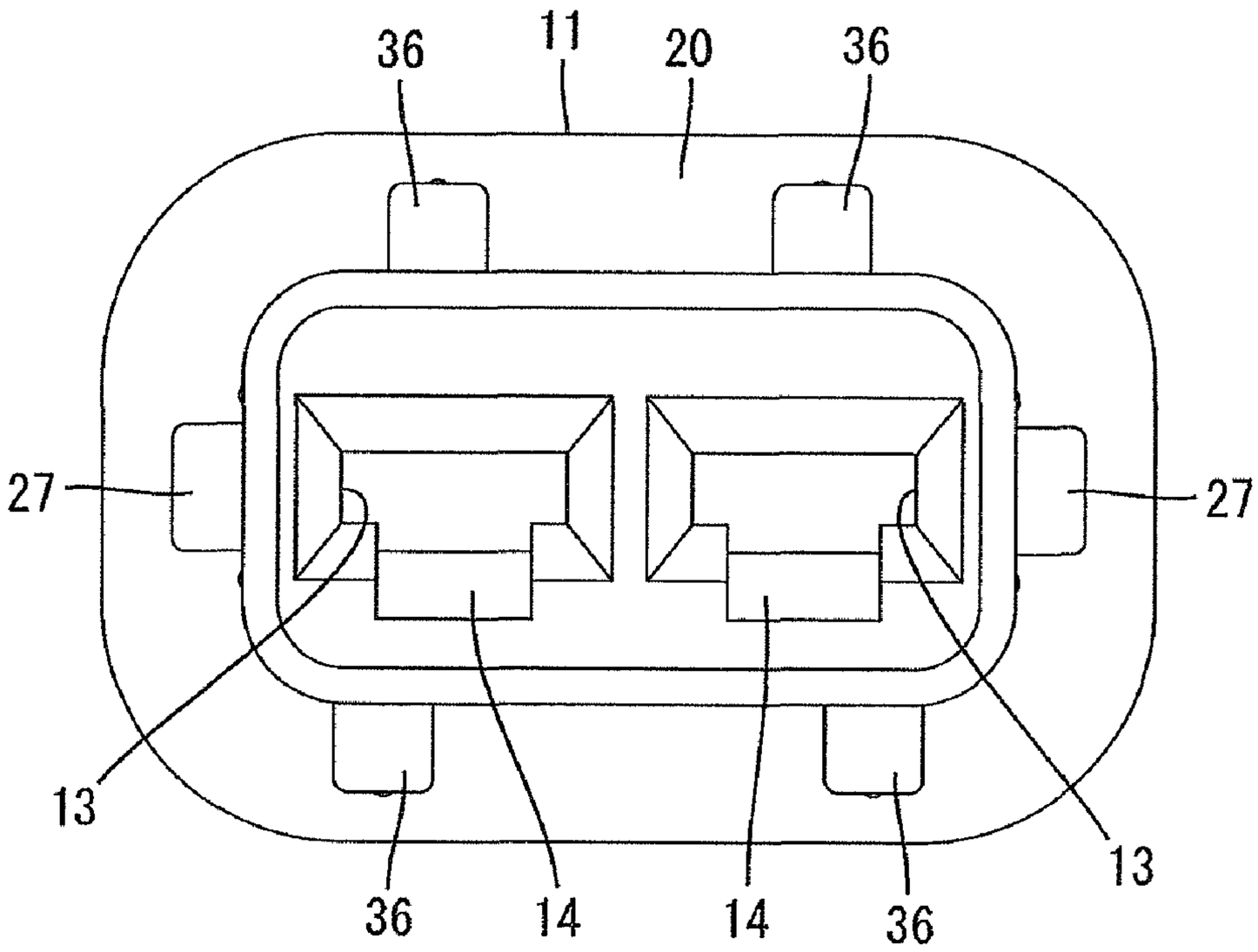


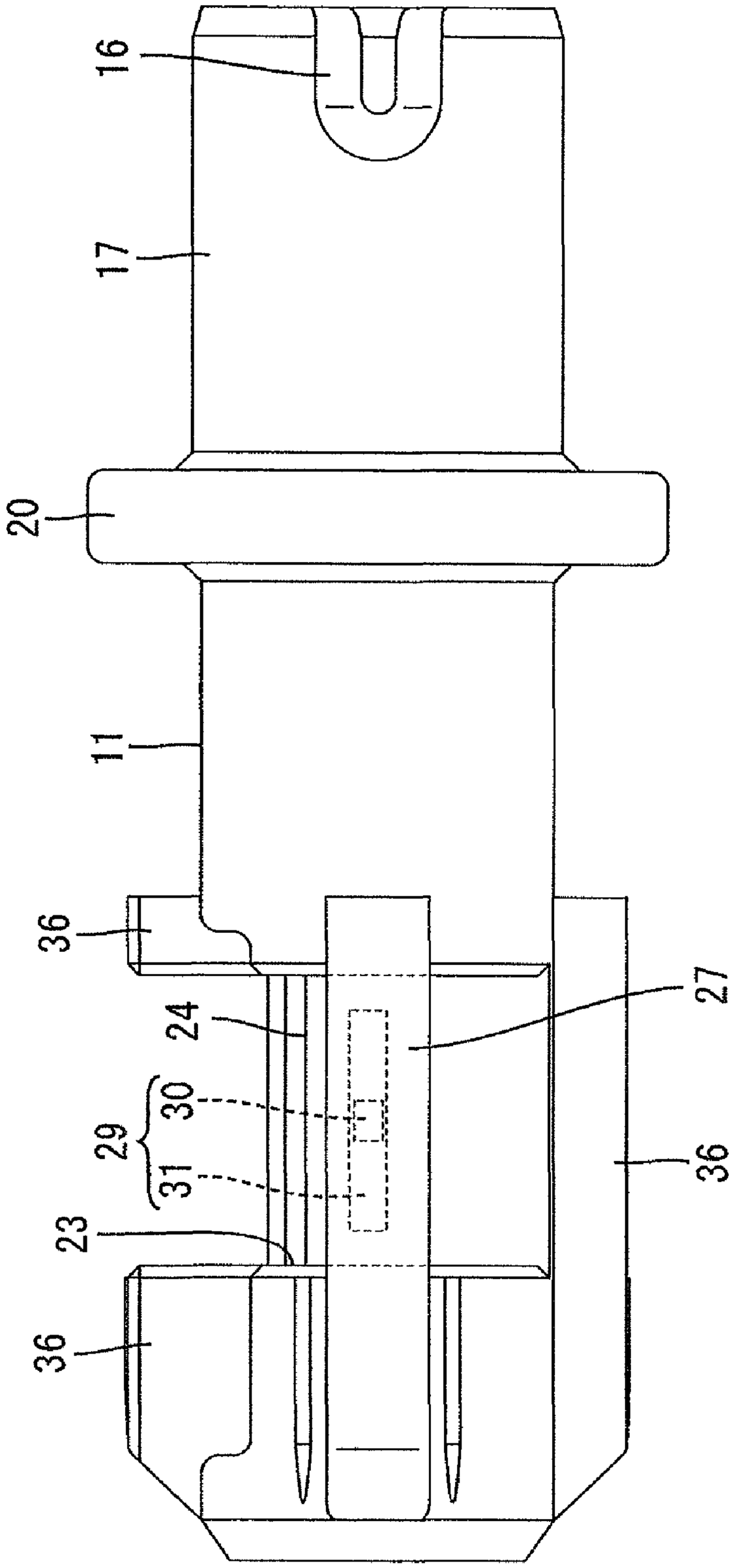


FIG. 12

FIG. 13

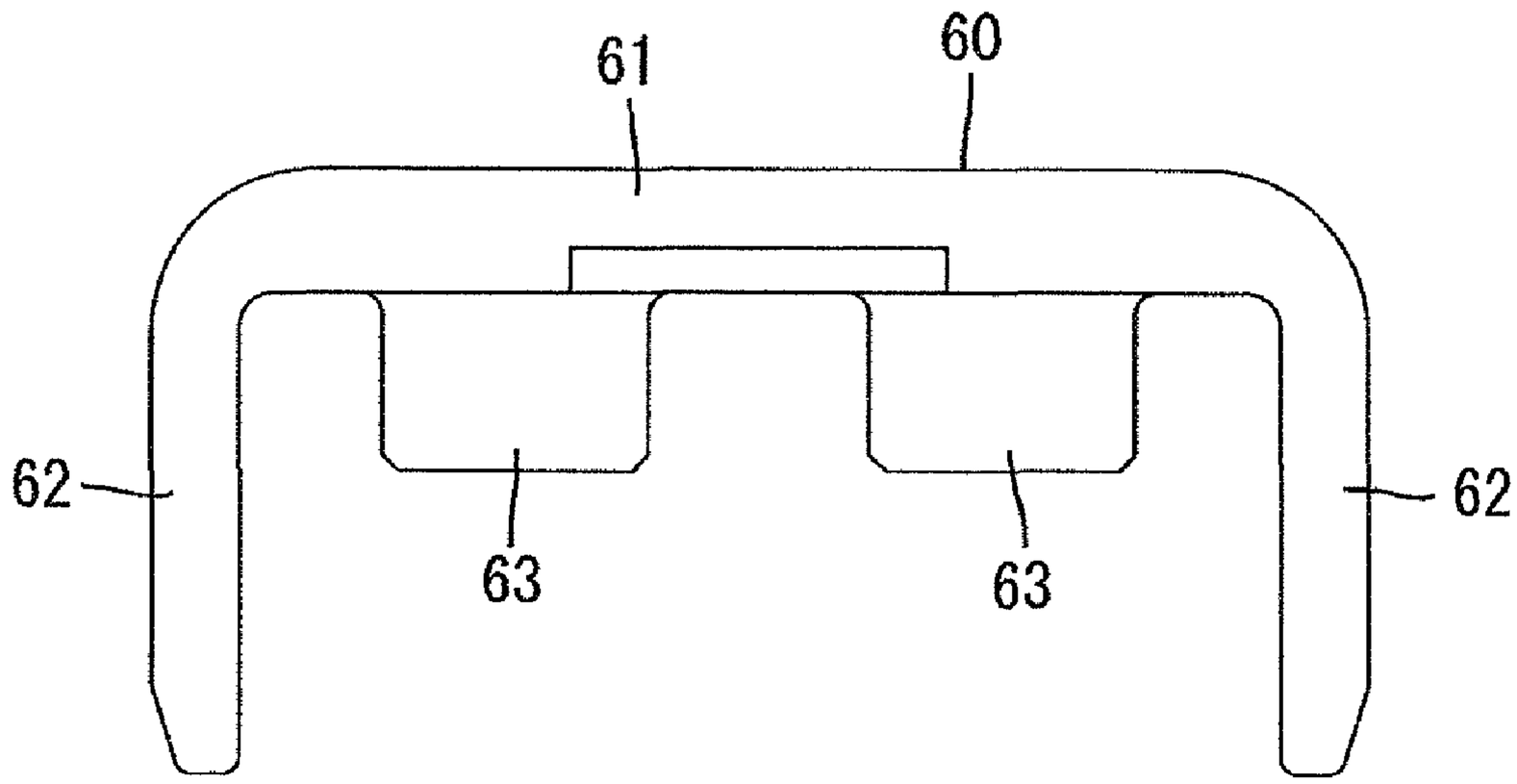
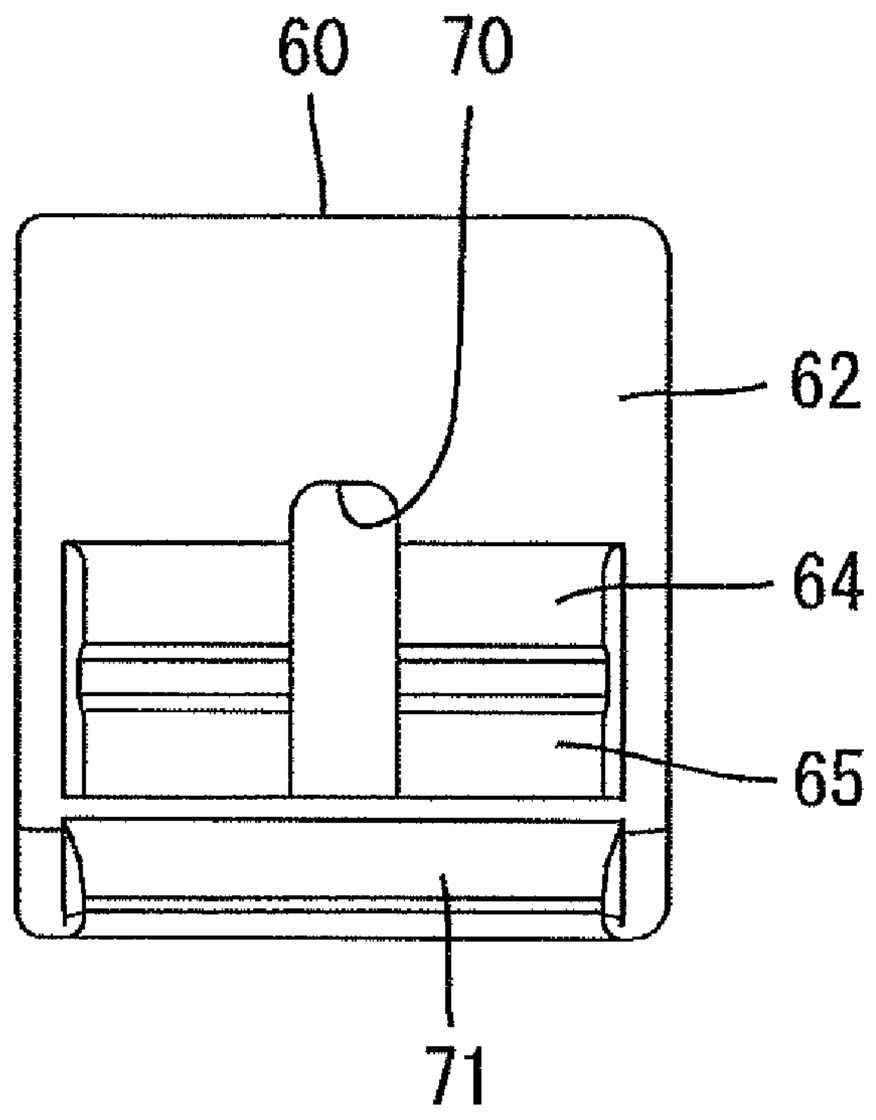


FIG. 14



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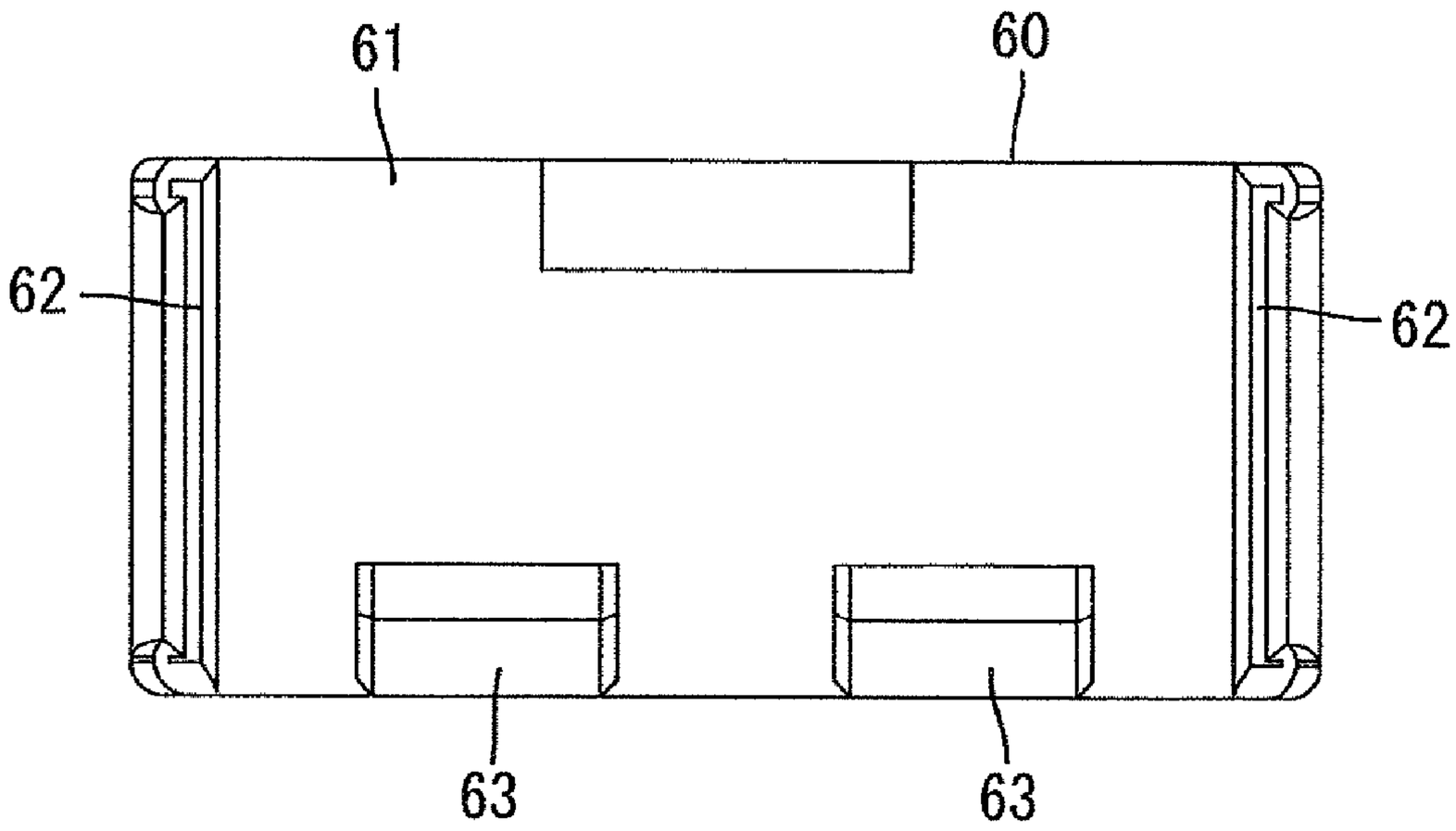

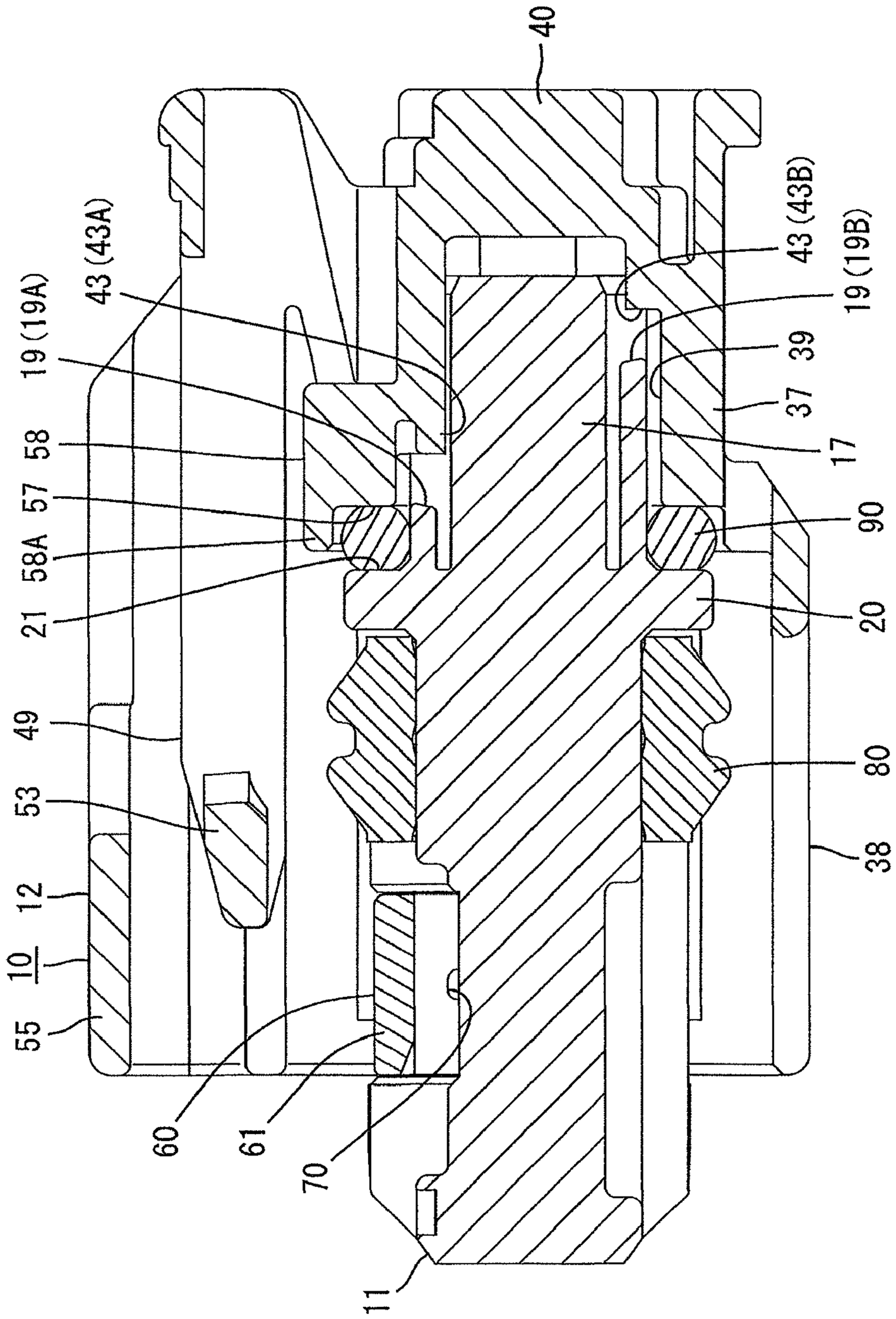
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FIG. 16

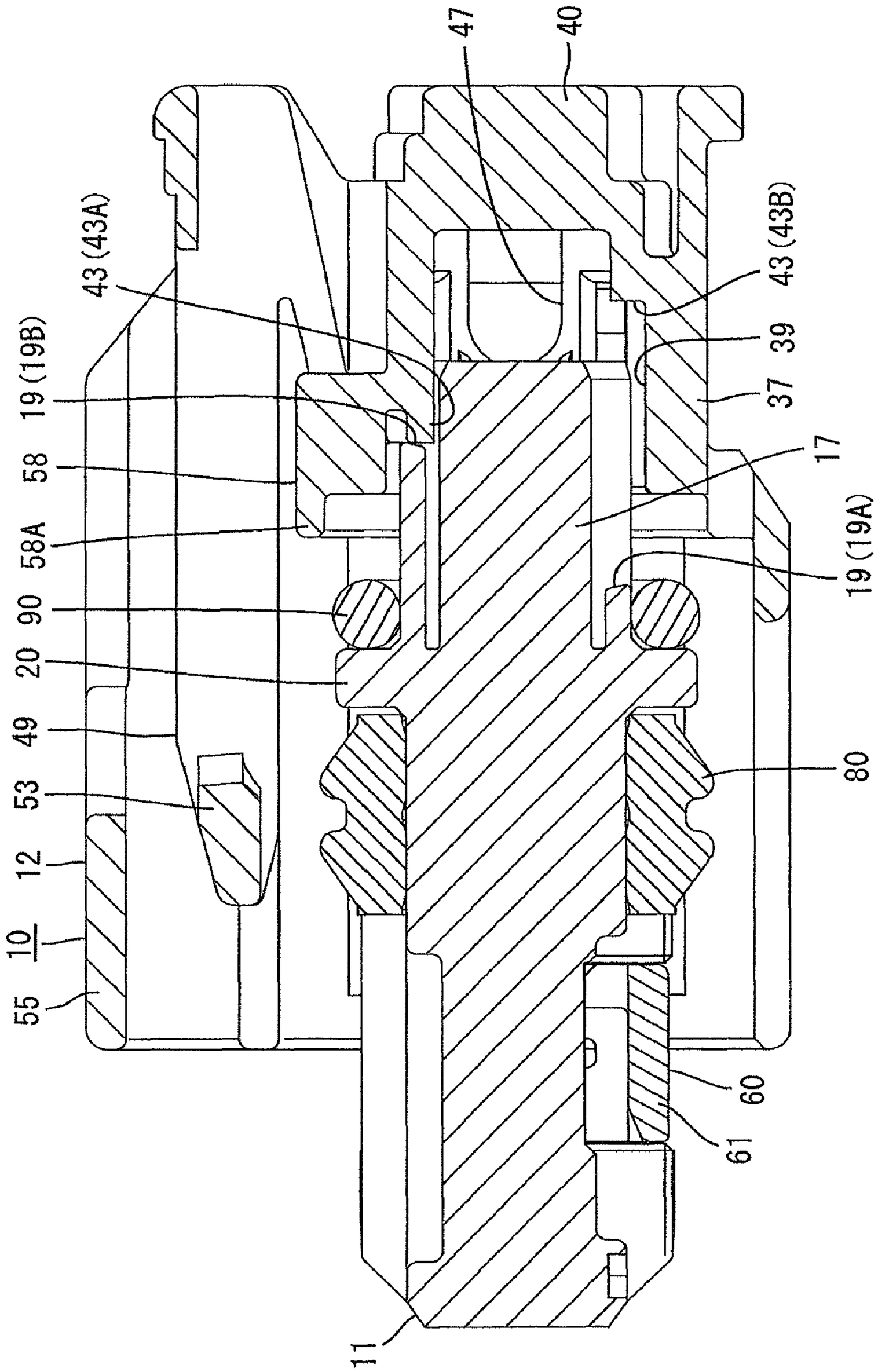
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FIG. 17

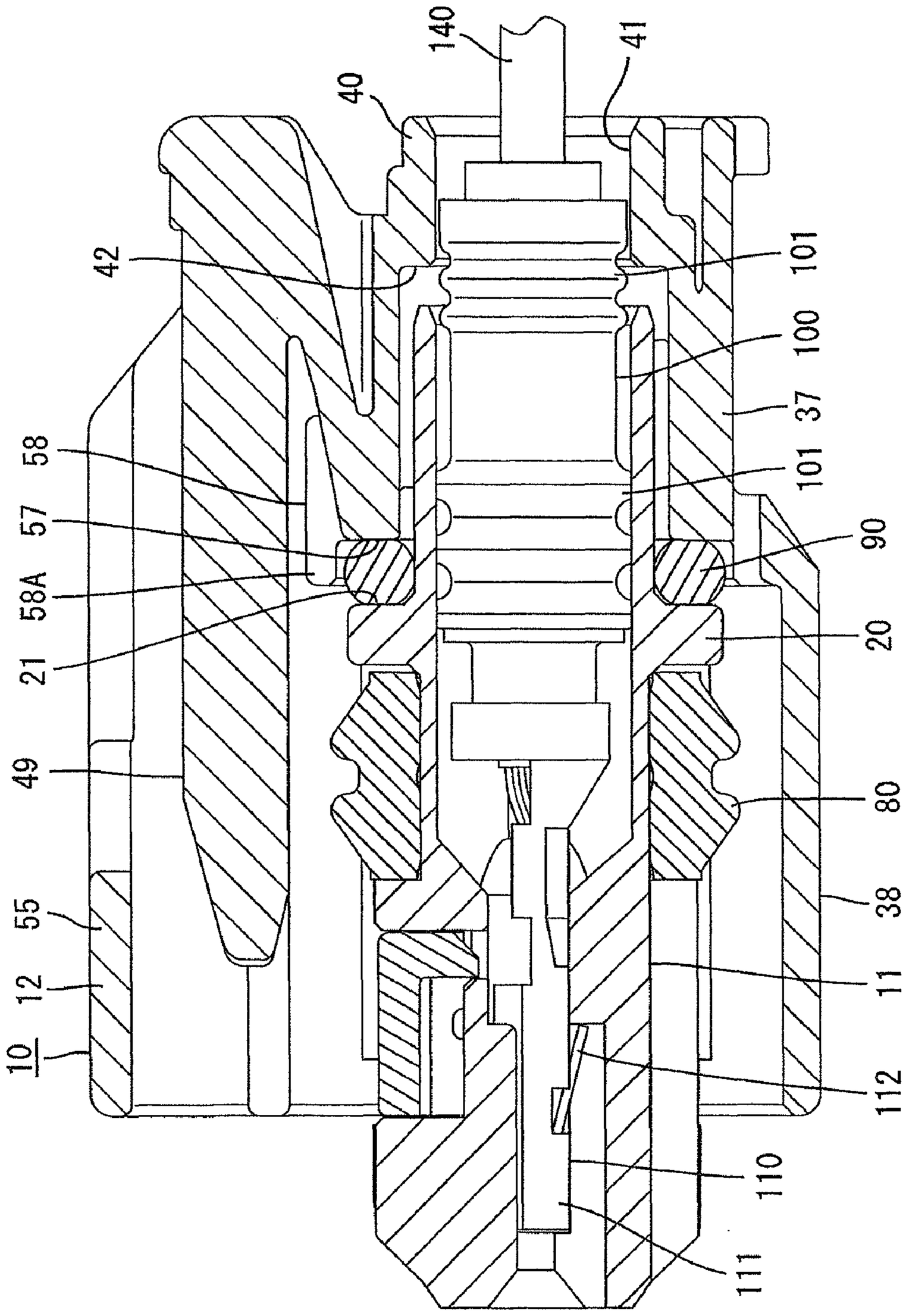
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FIG. 18

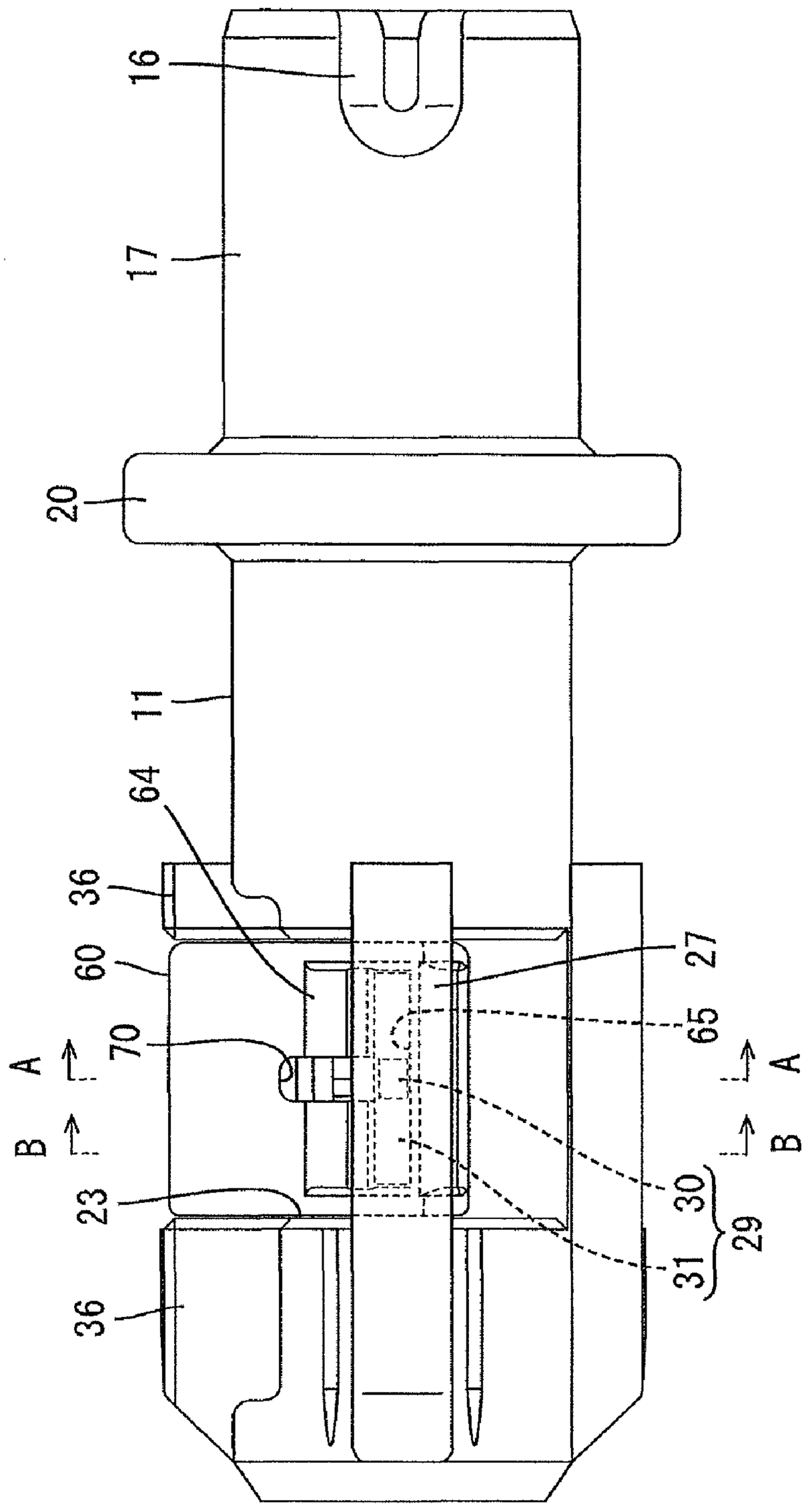


FIG. 19

FIG. 20

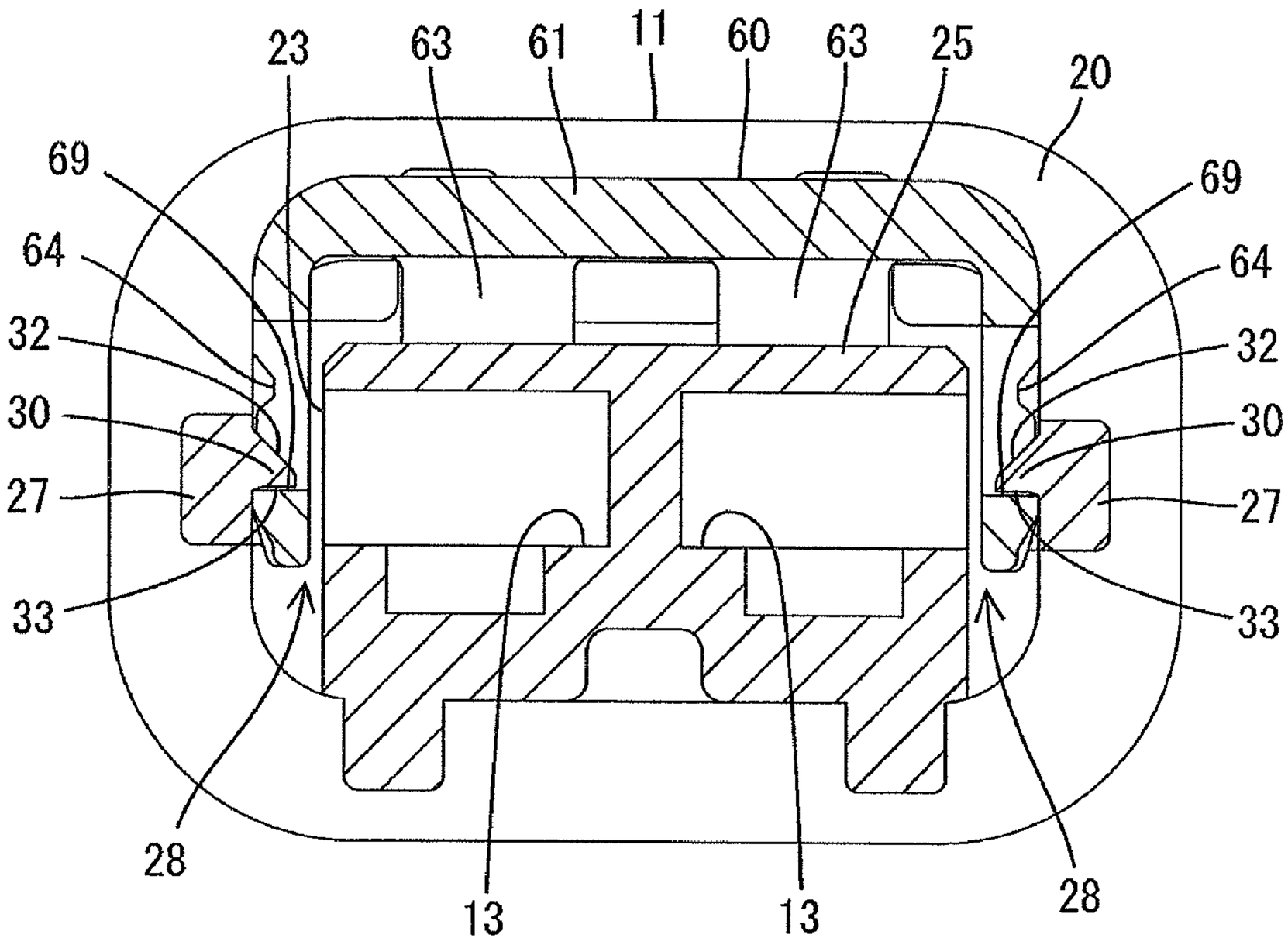
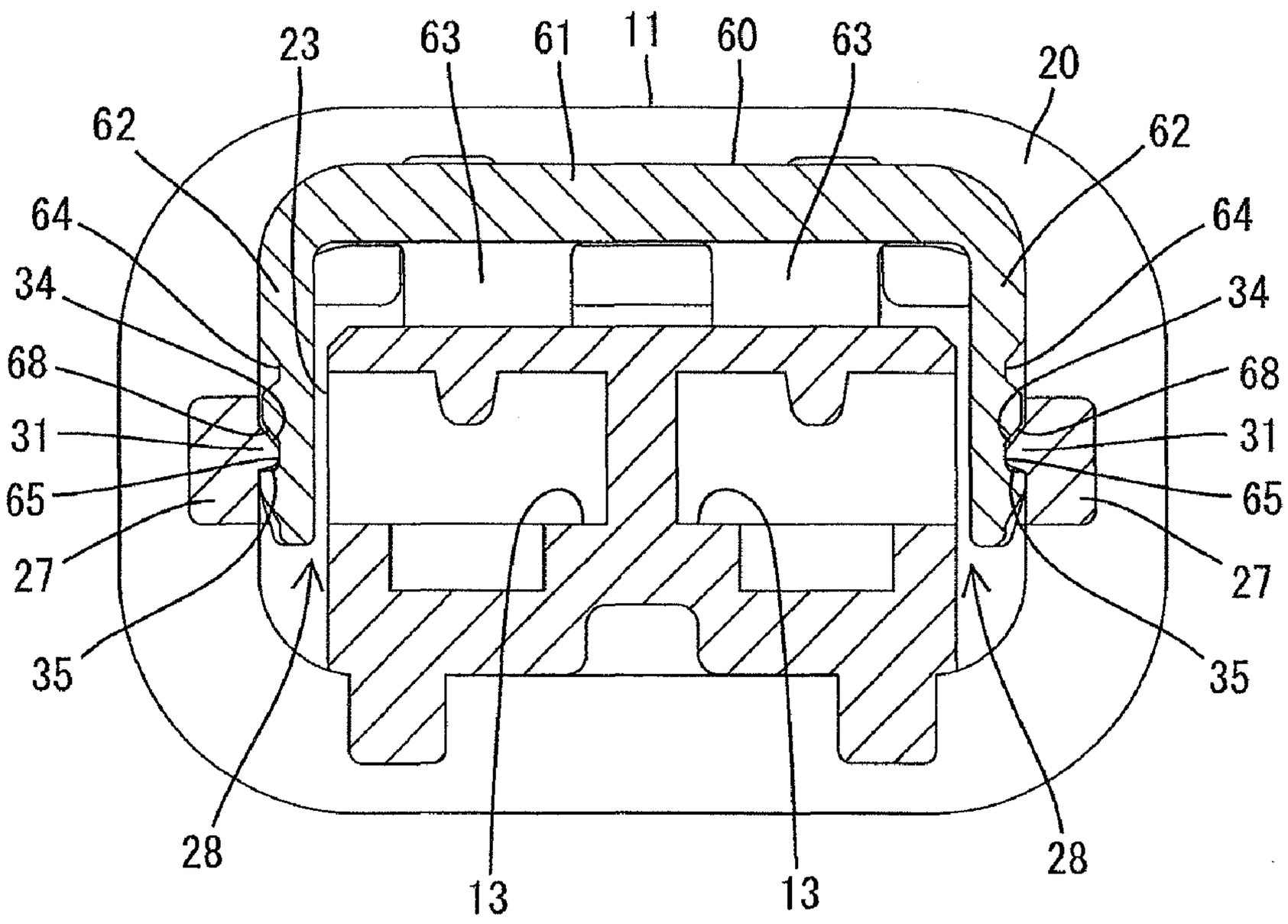


FIG. 21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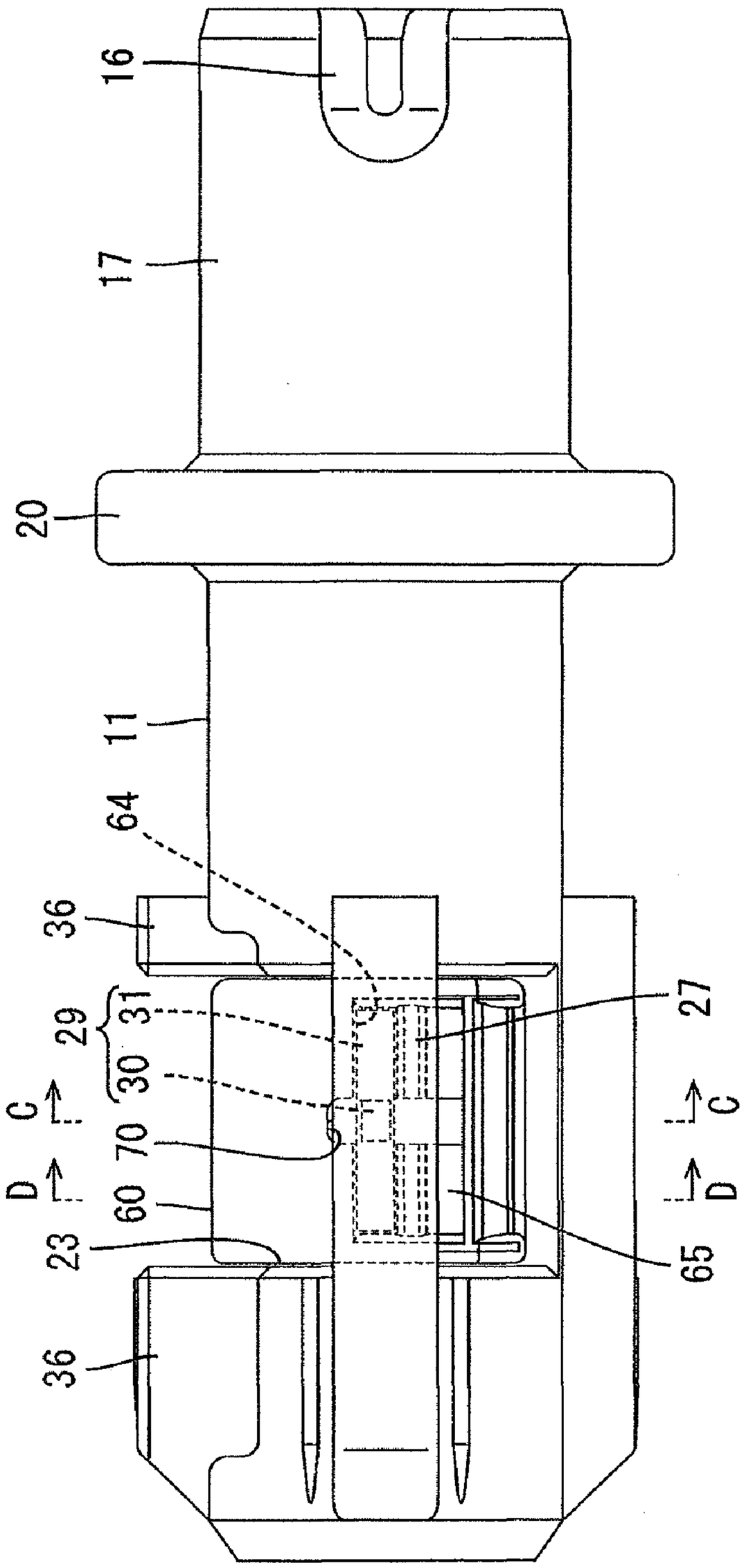


FIG. 22

FIG. 23

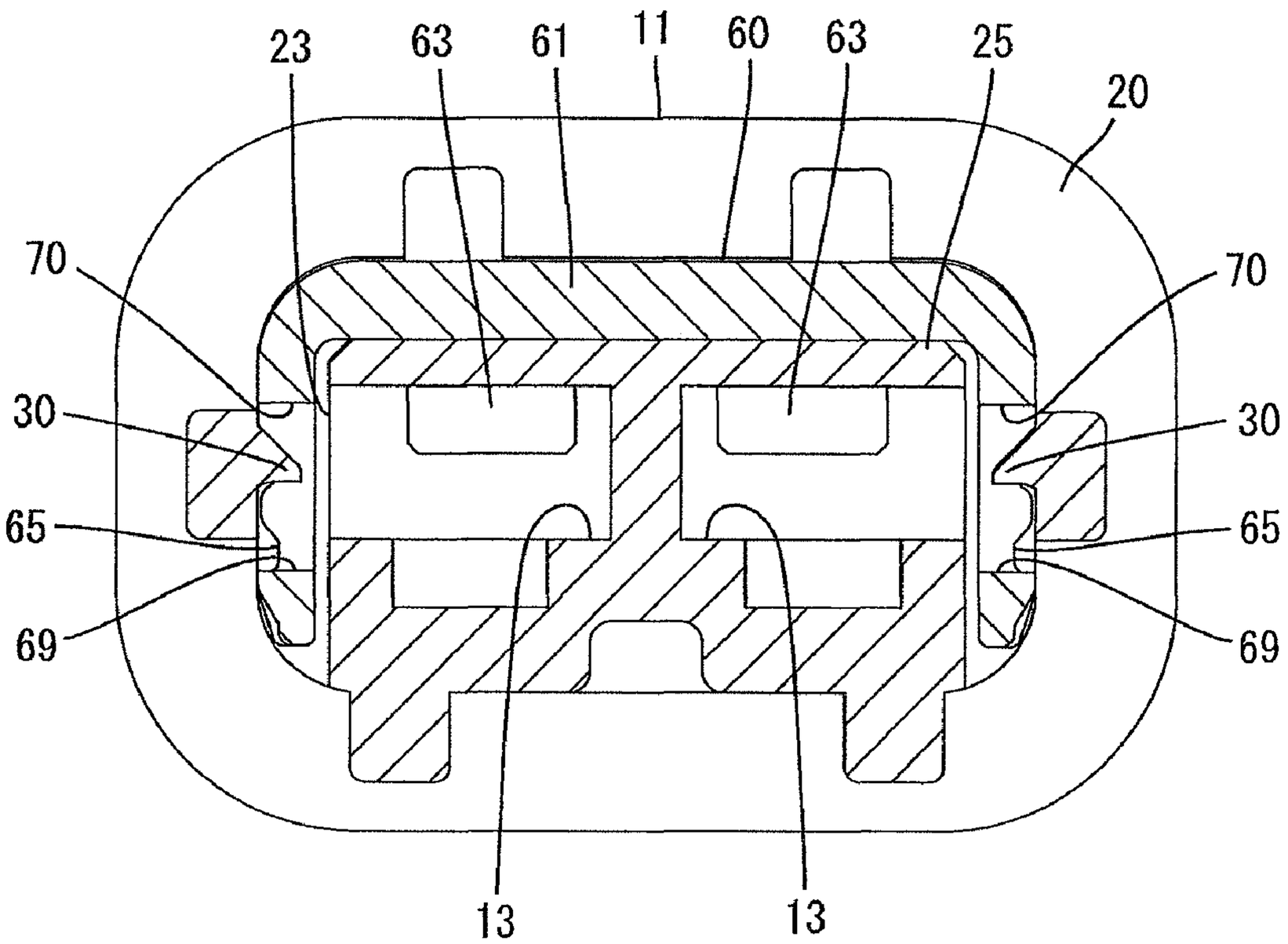
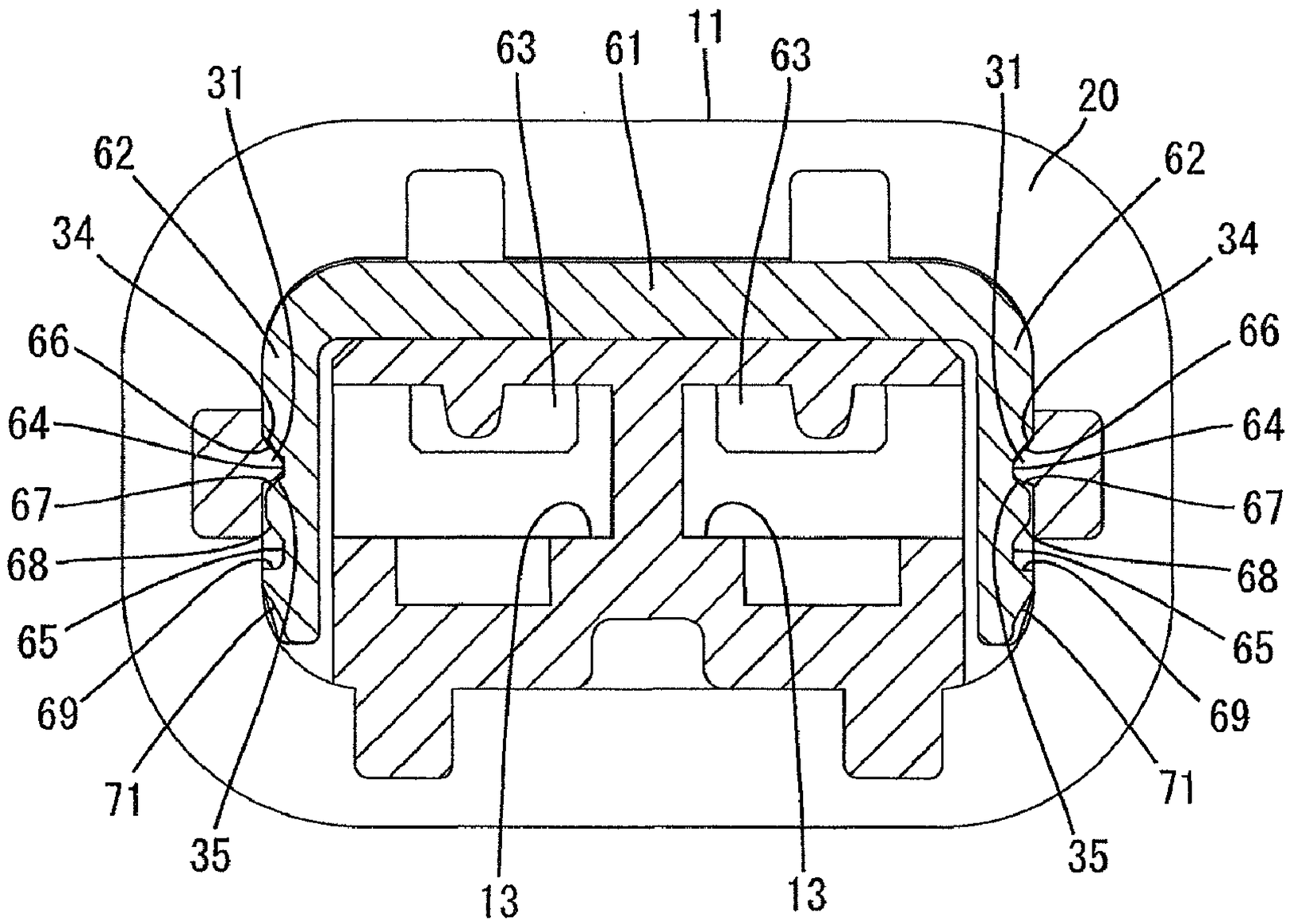


FIG. 24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CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a connector.

2. Description of the Related Art

A conventional connector has a housing into which terminal fittings can be inserted and a retainer mounted in a mounting hole of the housing for movement between a temporary locking position and a main locking position. A temporary locking concavity and a main locking concavity are formed side by side on an inner surface of the mounting hole. A flexible elastic piece is formed on the retainer and a locking projection is formed on the elastic piece. The locking projection can fit elastically in the temporary locking concavity to hold the retainer at the temporary locking position. The locking projection also can fit elastically in the main locking concavity to hold the retainer at the main locking position.

The main locking concavity has a first slope, the locking projection has a second slope and the temporary locking concavity has a third slope. The first slope is formed at a forward portion of the main locking concavity in the direction in which the retainer is drawn out and is inclined along the direction in which the retainer is drawn out. The third slope formed at a forward portion of the temporary concavity in the direction in which the retainer is drawn out and is inclined along the direction in which the retainer is drawn out. The second slope is disposed substantially along the surface direction of the third slope when the retainer is at the temporary locking position and is disposed substantially along the surface direction of the first slope when the retainer is at the main locking position. The retainer can be returned smoothly to the temporary locking position because the second slope slides on the first slope.

The retainer of the above-described connector can be moved from the main locking position to the temporary locking position. However, there are times when the second slope of the locking projection slides on the third slope of the temporary locking concavity so that the retainer separates from the housing without the being stopped at the temporary locking position.

The connector can be provided with a dedicated locking construction separate from the locking projection for securely stopping the retainer at the temporary locking position. However, the construction of the connector then becomes undesirably complicated.

The invention was completed based on the above-described situation. It is an object of the invention to prevent a retainer from being separated from a housing without a complicated construction.

SUMMARY OF THE INVENTION

The invention relates to a connector with a housing that can be fit on a mating housing and into which terminal fittings can be inserted. A retainer is mounted on the housing movably between a temporary locking position and a main locking position. The retainer allows the terminal fittings to be inserted into the housing at the temporary locking position, but prevents the terminal fittings from being drawn out of the housing at the main locking position. A temporary locking concavity and a main locking concavity are formed on one of the housing and the retainer. A locking projection is formed on the other of the housing and the retainer. The locking projection can fit elastically in the temporary locking concavity to hold the retainer at the temporary locking position. The

locking projection also can fit elastically in the main locking concavity to hold the retainer at the main locking position. The main locking concavity has a first slope on a forward surface thereof in a direction in which the retainer is drawn out. The first slope is inclined along the direction in which the retainer is drawn out. The temporary locking concave portion has a first locking surface on a forward surface thereof in the direction in which the retainer is drawn out. The first locking surface is substantially orthogonal to the direction in which the retainer is drawn out. The locking projection has a second slope on a forward surface thereof in the direction in which the retainer is drawn out. The second slope is disposed on the first slope substantially along a surface direction of the first slope at the main locking position. A second locking surface is formed on the forward surface of the locking projection in the direction in which the retainer is drawn out. The second locking surface is disposed substantially along a surface direction of the first locking surface at the temporary locking position.

The second slope of the locking projection preferably is disposed at both sides of the second locking surface.

An escape hole preferably is formed on one of the housing and the retainer at a position between the main locking concavity and the temporary locking concavity. The escape hole extends in a direction in which the retainer moves and receives the second locking surface of the locking projection during a movement of the retainer.

The first slope is formed on the forward surface of the main locking concavity in the direction in which the retainer is drawn out and the first slope inclines along the direction in which the retainer is drawn out. The second slope is formed on the forward surface of the locking projection in the direction in which retainer is drawn out by disposing the second slope substantially along the surface direction of the first slope at the main locking position. Therefore, the first and second slopes slide smoothly on each other when returning the retainer to the temporary locking position from the main locking position.

The temporary locking concavity has the first locking surface formed on the forward surface thereof in the direction in which the retainer is drawn out. The first locking surface is substantially orthogonal to the direction in which retainer is drawn out. The locking projection has the second locking surface disposed substantially along the surface direction of the first locking surface at the temporary locking position. Therefore, the first and second locking surfaces are locked together tightly as the retainer advances to the temporary locking position and the retainer cannot separate from the housing. In this case, the second slope and the second locking surface are formed together on the locking projection. Thus the housing has a simple construction as compared with a construction in which the second slope and the second locking surface are formed at different portions.

The second slope is disposed at both sides of the second locking surface. Thus, the retainer has a favorable balance in its movement posture when the first slope and second slopes slide on each other.

The second locking surface of the locking projection penetrates the escape hole during movement of the retainer. More particularly, the second locking surface is formed on the housing or the retainer by extending the escape hole in the movement direction of the retainer between the main locking concavity and the temporary locking concavity. Therefore the second locking surface does not interfere with the first slope and the retainer moves smoothly. In addition, this construction can secure a large locking area of the second locking surface to prevent removal of the retainer.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view showing a state in which a connector of an embodiment 1 of the present invention is normally fitted on a mating connector.

FIG. **2** is a sectional view of the connector.

FIG. **3** is a front view of the connector.

FIG. **4** is a rear view of an outer housing.

FIG. **5** is a plan view of the outer housing.

FIG. **6** is a sectional view of the outer housing.

FIG. **7** is a front view of the outer housing.

FIG. **8** is a rear view of an inner housing.

FIG. **9** is a plan view of the inner housing.

FIG. **10** is a bottom view of the inner housing.

FIG. **11** is a front view of the inner housing.

FIG. **12** is a side view of the inner housing.

FIG. **13** is a front view of a retainer.

FIG. **14** is a side view of the retainer.

FIG. **15** is a bottom view of the retainer

FIG. **16** is a sectional view showing a state in which the inner housing is normally mounted in the outer housing.

FIG. **17** is a sectional view showing a state in which an erroneous mounting of the outer housing on the inner housing is prevented.

FIG. **18** is a sectional view of the connector when the retainer is disposed at a temporary locking position.

FIG. **19** is a side view of the inner housing when the retainer is disposed at the temporary locking position.

FIG. **20** is a sectional view taken along a line of A-A of FIG. **19**.

FIG. **21** is a sectional view taken along a line of B-B of FIG. **19**.

FIG. **22** is a side view of the inner housing when the retainer is disposed at a main locking position.

FIG. **23** is a sectional view taken along a line of C-C of FIG. **22**.

FIG. **24** is a sectional view taken along a line of D-D of FIG. **22**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A connector in accordance with the invention has a housing **10** that can be fit on a mating housing **120**, as shown in FIG. **1**. In the following description, fit-on ends of the housings **10** and **120** are referred to as the front end and reference to the vertical direction is based on the orientation of FIG. **1**.

The mating housing **120** is made of synthetic resin and has a forwardly projecting tubular hood **121**, as shown in FIG. **1**. Tab-shaped mating terminal fittings **130** are arranged widthwise in the hood **121**. An unshown lock projects on an upper surface of an upper wall of the hood **121**.

The housing **10** has an inner housing **11** made of synthetic resin and an outer housing **12** made of synthetic resin that fits on the inner housing **11**.

The inner housing **11** is block-shaped and cavities **13** penetrate the inner housing **11** longitudinally. The cavities **13** are arranged widthwise in the inner housing **11**. A lance-receiving step **14** is formed on an inner surface of each cavity **13**. A sectionally circular sealing hole **15** having a longitudinally uniform diameter is formed at a rear of each cavity **13**.

Terminal fittings **110** are inserted into the cavities **13** from the rear. A tubular body **111** is formed at a front portion of each terminal fitting **110**. A flexible elastic locking piece **112** is formed on the body **111** by partly cutting and bending the cut part diagonally down and back. The elastic locking piece **112** elastically deflects and then locks to the lance-receiving

portion **14** when terminal fittings **110** are inserted normally into the respective cavities **13** to prevent the terminal fittings **110** from being removed from the cavities **13**. The mating terminal fittings **130** are inserted respectively into the bodies **111** of the terminal fittings **110** and connect when the housings **10** and **120** are fit together.

A rear end of the terminal fitting **110** is caulked into connection with an end of an electric wire **140** and a long tubular rubber stopper **100** is fit on the electric wire **140**. The rubber stopper **100** closely contacts the peripheral surface of the electric wire **140** and the inner peripheral surface of the sealing hole **15** when the terminal fittings **110** are inserted normally into the respective cavities **13**.

As shown in FIGS. **8** through **10**, two inner locks **16** project widthwise at a rear end of the inner housing **11**.

Two cylindrical towers **17** are formed at a rear part of the inner housing **11** and are arranged widthwise. The sealing holes **15** are disposed inside each tower **17**. A joining portion **18** is formed at the center of the rear part of the inner housing **11** and joins the adjacent towers **17**. The joining portion **18** is a thin vertical wall that partitions the adjacent sealing holes **15** from each other.

The space between the adjacent towers **17** is partitioned with circular peripheral surfaces of the towers **17** to form concavities **19** that open up and down like a trumpet in a sectional view. The upper and lower concavities **19** are constructed that their lengths (same as depth) from an open end at the rear of the tower **17** to an inner end are different from each other. More specifically the upper concavity **19**A is longer than the lower concavity **19**B. Front and rear ends of the lower concavity **19**B are coincident with front and rear ends of the inner locks **16**. The extended length of the upper concavity **19**A is two to three times longer than the lower concavity **19**B.

A flange **20** projects from the outer surface of the inner housing **11** and extends around the entire periphery of the inner housing **11**. A wide ring-shaped elastic member **90** is fit on the outer surface of the inner housing **11** rearward of the flange portion **20** so that the front surface of the elastic member **90** contacts a first contact surface **21** on the rear of the flange **20**. Upper and lower thick portions **22** are formed between the towers **17** of the inner housing **11** and extend from the inner end of the concavity to the rear end of the flange **20**. The lower thick portion **22**B is two to three times longer than the upper thick portion **22**A.

A mounting hole **23** is formed through the outer surface of the inner housing **11** and can receive a retainer **60** from above. A concave space **24** (see FIG. **9**) is formed on an upper surface and both side surfaces of the inner housing **11** at positions corresponding to the mounting hole **23** by stepping down the concave space **24**. A thin wall **25** (see FIG. **23**) is formed on a bottom of the concave space **24** and partitions the cavities **13** from the retainer **60**. Two approximately rectangular insertion holes **26** (FIG. **9**) are formed through the upper thin wall **25** and can receive a removal prevention part **63**. The insertion holes **26** communicate with the respective cavities **13**.

Two bridges **27** are formed on both side surfaces of the inner housing **11** and straddle the mounting hole **23**. Each bridge **27** bulges out from both side surfaces of the inner housing **11** and extends longitudinally. A penetration space **28** (FIG. **9**) is formed at an inner side of each bridge **27** and defines both ends of the mounting hole **23** in the width direction.

A longitudinally extending rib-shaped locking projection **29** projects from an inner surface of each bridge **27**. The locking projection **29** includes a first lock **30** at a central portion of each bridge **27** in the longitudinal direction thereof

and a second lock **31** disposed at both sides of the first lock **30**. The first lock **30** projects farther than the second lock **31**.

As shown in FIG. **20**, a third slope **32** is formed on an upper surface of the first lock **30** (forward surface in the direction in which retainer **60** is mounted) and inclines along the direction in which retainer **60** is mounted. A second locking surface **33** is formed on a lower surface of the first lock **30** (forward surface in the direction in which retainer **60** is drawn out) and is approximately orthogonal to the directions in which retainer **60** is mounted and drawn out. As shown in FIG. **21**, a fourth slope **34** is formed on an upper surface of the second lock **31** and inclines along the direction in which retainer **60** is mounted. A second slope **35** is formed on a lower surface of the second lock **31** and inclines along the direction in which retainer **60** is drawn out. The fourth slope **34** is formed as a pair disposed at both sides of the third slope **32**. The second slope **35** is formed as a pair disposed at both sides of the second locking surface **33**. The inner ends of the third slope **32** and the second locking surface **33** are disposed inward from the inner ends of the fourth slope **34** and second slopes **35**.

More specifically, the third and fourth slopes **32** and **34** are tapered and gradually open out toward their upper ends. The second slope **35** is tapered and gradually opens out toward the lower end. The second locking surface **33** is a substantially flat horizontal surface.

As shown in FIG. **12**, ribs **36** extend longitudinally on the upper and lower surfaces of the inner housing **11**. Each rib **36** fits in an unshown receiving groove of the mating housing **120** to guide the housings **10** and **120** during a connecting operation. Additionally both housings **10** and **120** are prevented from being fit together erroneously. The upper rib **36** is divided into front and rear portions via an opening formed through the upper surface. As shown in FIG. **2**, a ring-shaped sealing member **80** is fit on the inner housing **11**. The sealing member **80** is made of rubber is disposed longitudinally at a predetermined position between the rib **36** and the flange **20**.

The retainer **60** is made of synthetic resin to define a wide body **61** and two substantially parallel elastic pieces **62** projected from widthwise ends of the body **61**, as shown in FIG. **13**. Thus, the retainer is substantially U-shaped. The retainer **60** is movable between a temporary locking position where the retainer **60** is mounted shallowly on the inner housing **11** and a main locking position where the retainer **60** is mounted deeply on the inner housing **11**.

The body **61** is fit in the upper concave space **24** of the inner housing **11**. At the main locking position, the body **61** is supported by the thin wall **25**. Two removal prevention parts **63** project on a rear part of the lower surface of the body **61** at positions corresponding to the cavities **13** and can penetrate through the respective insertion holes **26**. Each removal prevention part **63** is approximately rectangular in front view. The removal prevention part **63** is offset from the cavity **13** at the temporary locking position, thus allowing the terminal fitting **110** to be inserted into or removed from the cavity **13**. The removal prevention part **63** is in the cavity at the main locking position, to prevent the terminal fitting **110** from being removed from the cavity **13**.

Each elastic piece **62** is flexible widthwise about a root that is continuous with the body **61**. The penetration space **28** of the inner housing **11** includes an insertion region into which the elastic piece **62** is inserted and a region inward from the insertion region in which the elastic piece **62** flexes.

As shown in FIG. **14**, a main locking concavity **64** and a temporary locking concavity **65** are arranged vertically on an outer surface of each elastic piece **62** and can receive the locking projection **29**. The main locking concavity **64** is above the temporary locking concavity **65**. A guide concavity **71** is formed on the outer surface of a distal end of each elastic piece **62** at a position below the temporary locking concavity **65** for guiding an insertion of each elastic piece **62** into the penetration space **28**.

The main and temporary locking concavities **64** and **65** are bottomed grooves that extend longitudinally from the front end of each elastic piece **62** to the rear end thereof and have almost equal depths. As shown in FIG. **24**, a fifth slope **66** is formed on an upper surface of the main locking concavity **64** (forward surface in the direction in which retainer **60** is mounted) and inclines along the direction in which retainer **60** is mounted. A first slope **67** is formed on a lower surface of the main locking concavity **64** (forward surface in direction in which retainer **60** is drawn out) and inclines along the direction in which retainer **60** is drawn out. A sixth slope **68** is formed on an upper surface of the temporary locking concavity **65** and inclines along the direction in which retainer **60** is mounted. A first locking surface **69** is formed on a lower surface of the temporary locking concavity **65** and is substantially orthogonal to the directions in which retainer **60** is mounted and drawn out.

The fifth and sixth slopes **66** and **68** are tapered to open gradually out toward their upper ends. The first slope **67** is tapered to open gradually out toward the lower end thereof. The first locking surface **69** is substantially flat and horizontal. Inclinations of the fifth and sixth slopes **66** and **68** are almost equal.

An escape hole **70** penetrates each elastic piece **62** at a position between the main and temporary locking concavities **64** and **65** for receiving the first lock **30** of the locking projection **29** during movement of the retainer **60**. As shown in FIGS. **14** and **23**, the escape hole **70** is a vertically long slit in which the locking projection **29** of the retainer **60** is moved. The lower end of the escape hole **70** is partitioned by the first locking surface **69** of the temporary locking concavity **65**. The upper end of the escape hole **70** is slightly above the upper end of the main locking concavity **64**. The escape hole **70** is at a central portion of each elastic piece **62** in the longitudinal direction thereof and is formed across the central portion of the main and temporary locking concavities **64** and **65** in the longitudinal direction thereof. Therefore each of the main and temporary locking concavities **64** and **65** is divided into front and rear portions through the escape hole **70**.

The outer housing **12** is made of synthetic resin. As shown in FIGS. **6** and **7**, the outer housing **12** has a tubular body **37** and a tubular fit-on part **38**. The tubular fit-in part **38** is larger than the body **37** and projects forward from the body **37**.

A forwardly open receiving portion **39** is formed on the body **37** of the outer housing **12** for receiving each tower **17**. An opposed tubular portion **40** projects at a rear part of the body **37** of the outer housing **12** opposed to the rear end of each tower **17** fit in the receiving portion **39**. The opposed tubular portion **40** defines a double-barreled tube corresponding to each tower **17**. An opposed sealing hole **41** is formed inside the opposed tubular portion **40** and communicates with the sealing hole **15**. As shown in FIG. **2**, the rear portion of the rubber stopper **100** closely contacts the opposed sealing hole **41** and liquid-tightly seals the opposed sealing hole **41**. The rubber stopper **100** is fit on the sealing hole **15** and the opposed sealing hole **41** and straddles both holes **15** and **41**. Lips **101** extend around the periphery of the rubber stopper **100** for elastically closely contacting both holes **15** and **41**.

A step **42** extends radially at a front edge of the opposed tubular portion **40** and is continuous with an inner peripheral surface of the receiving portion **39**. Rib-shaped convexities **43** are formed at upper and lower sides of an inner surface of

the receiving portion **39** and extend forward a predetermined length from the step **42**. The convexities **43** are disposed at widthwise central portions of the body **37**. The upper and lower convexities **43** are inserted into the upper and lower concavities **19** in a normal depth when each tower **17** is fit normally in the receiving portion **39**, i.e., when the outer housing **12** is fit normally on the inner housing **11**. At this time, an outer surface of each convexity **43** is spaced at a certain interval from an inner surface of each concavity **19** (see FIG. **16**).

As shown in FIG. **6**, the upper and lower convexities **43** extend different lengths forward from the stepped surface **42**. More specifically, the extended length of the upper convexity **43**A is long in correspondence to the upper concavity **19**A, whereas the extended length of the lower convexity **43**B is shorter than that of the upper convexity **43**A in correspondence to the lower concavity **19**B. Thus, the front end of the lower convexity **43**B is rearward from the front end of the upper convexity **43**A. The front end of the lower convexity **43**B is at a position where the body **37** of the outer housing **12** and the fit-on tubular part **38** are connected to each other. The extended length of the upper convexity **43**A is two to three times longer than the lower convexity **43**B.

As shown in FIG. **7**, the lower convexity **43**B is open like a trumpet toward the lower end in a sectional view and has two circular arc surfaces **44** with sharp leading ends that become substantially parallel with the inner surface of the concavity **19** when the towers **17** are fit normally in the receiving portion **39**. On the other hand, the upper convexity **43**A is sectionally triangular and tapers open toward the upper end with straight opposite sides **45** and an open angle corresponding to the concavity **19**A when the towers **17** are fit normally in the receiving portion **39**. The upper convexity **43**A is forwardly convex and interferes with the lower concavity **19**B when an erroneous fit-on is performed. An approximately V-shaped rib-like reinforcement **46** is formed along both opposite sides **45** at the front edge of the upper convexity **43**A.

Two inner locking receiving portions **47** penetration through the side walls of the body **37** of the outer housing **12** and elastically receive an inner locking portion **16** when each tower **17** is fit normally in the receiving portion **39**. Forwardly open guide grooves **48** are formed on the inner surfaces of both sides walls of the body **37** of the outer housing **12** for guiding the inner locks **16** into the inner locking receiving portion **47**. Engagement of the inner locks **16** in the inner locking receiving portion **47** prevents separation of the inner and outer housing **11** and **12**.

A locking arm **49** projects from a widthwise central portion of an upper surface of an upper wall of the body **37** of the outer housing **12**. More specifically the locking arm **49** has two legs **50** that extend diagonally up and rearward from the front end of the body **37**, two arms **51** that extend forward almost straight from upper ends of the legs **50**, an operation portion **52** connected to rear ends of both arms **51**, and a body **53** connected to front ends of both arms **51**. A locking groove **54** is formed between the arms **51**, forward from the operation portion **52** and rearward from the body **53** and can receive the lock of the mating housing **120**. The lock of the mating housing **120** interferes with the body **53** while fitting the housing **10** and the mating housing **120** together, and the arms **51** deform down about the legs **50**. The arms **51** return resiliently to their original state when the housing **10** and the mating housing **120** are fit normally together so that the lock fits in the locking groove **54** to hold the housing **10** and the mating housing **120** together. The operation portion **52** can pressed to separate the lock from the locking groove **54** so that the housing **10** and the mating housing **120** can be separated.

A bulge **55** bulges out from an upper wall of the fit-on tubular part **38** and the locking arm **49** is disposed inside the bulge **55**. As shown in FIG. **5**, a window **56** is formed on an upper wall of the bulge **55** to expose the locking arm **49** visibly.

Second contact surfaces **57** extend radially out at upper and lower positions of the front edge of the body **37** of the outer housing **12** for contacting the elastic member **90** from the rear. The second contact surfaces **57** of the body **37** are parallel to and opposed to the first contact surface **21** of the flange **20** to provide a space for sandwiching the elastic member **90** between the first and second contact surfaces **21** and **57**.

The elastic member **90** is sandwiched between the first contact surface **21** of the flange portion **20** and the second contact surface **57** of the body **37** of the outer housing **12** in a compressed state when the housing **10** and the mating housing **120** are fit normally together. At this time, force for longitudinally separating the housing **10** and the mating housing **120** acts therebetween due to an elastic restoring force of the elastic member **90**. Thus, the housings **10** and **120** are prevented from loosening.

A hold-down part **58** for suppressing outward elongation of the elastic member **90** projects on the upper surface of the upper wall of the body **37** of the outer housing **12**. The hold-down part **58** has a raised portion **58**B rising from the front end of the upper wall of the body **37** and a protrusion **58**A projects forward from the upper end of the raised portion **58**B. Thus, the hold-down part **58** is L-shaped in section. The protrusion **58**A is spaced out from the elastic member **90** when the elastic member **90** is in an uncompressed state. However, the protrusion **58**A contacts the elastic member **90** from a radially outward side and holds the elastic member **90** down when the elastic member **90** is in a highly compressed state.

The hold-down part **58** radially overlaps the locking arm **49** at a central part of the body **37** of the outer housing **12** in the width direction and is between the legs **50** of the locking arm **49** in a front view. The locking groove **54** of the locking arm **49** is above the hold-down part **58** so that the hold-down part **58** is visible through the locking groove **54**.

The retainer **60** is inserted into the mounting hole **23** of the inner housing **11** and held at the temporary locking position. At the temporary locking position, the outer surface of the body **61** is continuous and flush with that of the inner housing **11** (see FIG. **18**), and the second lock **31** of the locking projection **29** of the inner housing **11** is fit elastically into the temporary locking concavity **65** of the retainer **60** (see FIG. **19**). At this time, as shown in FIG. **20**, the second locking surface **33** of the locking projection **29** is disposed so that the first and second locking surfaces **69** and **33** of the temporary locking concavity **65** are almost orthogonal to the direction in which the retainer **60** is drawn out. Thus, the retainer **60** is prevented from being removed from the inner housing **11**. At the temporary locking position, the first lock **30** of the locking projection **29** penetrates into the escape hole **70** and thus cannot interfere with the retainer **60**, and the fourth slope **34** of the locking projection **29** is disposed substantially along the surface direction of the sixth slope **68** of the temporary locking concavity **65** with the second slope **35** of the locking projection **29** being spaced at a certain gap from the first locking surface **69** of the temporary locking concavity **65**, as shown in FIG. **21**.

The terminal fittings **110** are inserted into the cavities **13** in this state. The body **61** of the retainer **60** is pressed from above after all terminal fittings **110** are inserted into the cavities **13** so that the retainer **60** is moved toward the main locking position. The fourth slope **34** of the locking projection **29**

slides on the sixth slope **68** of the temporary locking concavity **65** during the movement of the retainer **60**, and the elastic piece **62** is deformed flexibly in the flexible space. The elastic piece **62** restores elastically to its original state when the retainer **60** reaches the main locking position, and the second lock **31** of the locking projection **29** fits into the main locking concavity **64** (see FIG. **22**). At this time, as shown in FIG. **24**, the second slope **35** of the locking projection **29** is disposed substantially along the surface direction of the first slope **67** of the main locking concavity **64**, and the fourth slope **34** of the locking projection **29** is disposed along the surface direction of the fifth slope **66** of the main locking concavity **64**. Thus, the retainer **60** is held at the main locking position in a movement prevention state.

The first lock **30** of the locking projection **29** penetrates into the escape hole **70** and does not interfere with the retainer **60** while the retainer **60** is moving toward the main locking position and after the retainer **60** reaches the main locking position, as shown in FIGS. **20** and **23**. The outer surface of the body **61** of the retainer **60** is lower than the outer surface of the inner housing **11** when the retainer **60** reaches the main locking position, as shown in FIG. **2**, and the removal prevention part **63** of the retainer **60** is at the rear end of the body **111** of the terminal fitting **110** so that the terminal fitting **110** cannot be removed from the cavity **13**.

The retainer **60** may be returned to the temporary locking position for maintenance or the like by pulling the body **61** of the retainer **60** up toward the temporary locking position. The second slope **35** of the locking projection **29** slides on the first slope **67** of the main locking concavity **64** while the retainer **60** is being moved to the temporary locking position, and the elastic piece **62** of the retainer **60** is deformed in the flexing space. The elastic piece **62** restores elastically to its original state when the retainer **60** reaches the temporary locking position. As a result, as shown in FIG. **20**, the second locking surface **33** of the locking projection **29** contacts the first locking surface **69** of the temporary locking concavity **65** along a direction orthogonal to the direction in which the retainer **60** withdrawn. Thus, the retainer **60** cannot accidentally pass the temporary locking position and slip out of the inner housing **11**.

The terminal fitting **110** can be inserted into the cavity **13** after the inner housing **11** is mounted in the outer housing **12**. To mount the inner housing **11** in the outer housing **12**, the convex portion **43** of the outer housing **12** is fit into the concave portion **19** of the inner housing **11**. The front end of the convex portion **43** advances deep into the inner side of the concave portion **19** as the mounting operation proceeds. The inner lock **16** elastically locks to the inner locking receiving portion **47** when the convex portion **43** is fit into the concave portion **19** in a normal depth (see FIG. **16**). Thus the inner housing **11** is held in the outer housing **12** in a fit-in state.

The inner housing **11** could be in an inverted posture during an attempt to mount the inner housing **11** in the outer housing **12**, as shown in FIG. **17**. However, the front end of the long convexity **43**A (disposed at upper side in normal posture) interferes with the inner end of the short concavity **19**B (disposed at lower side in normal posture) before the long convexity **43**A is fit in the shallow concavity **19**B, thereby preventing further fitting of the inner housing **11** in the outer housing **12**. Hence, the inner housing **11** cannot be fit in the outer housing **12** in an erroneous posture. Additionally, the long convexity **43**A is sectionally triangular and hardly undergoes plastic deformation, upon contact with the inner end of the concavity **19**B.

The elastic member **90** is compressed slightly between the first contact surface **21** of the flange **20** and the second contact surface **57** of the body **37** of the outer housing **12** before the housing **10** is fit on the mating housing **120** in a state in which the inner housing **11** is fit normally in the outer housing **12**. However, the elastic member **90** is spaced at a certain gap from the hold-down part **58**.

The mating housing **120** then is fit on the fit-on tubular part **38** of the outer housing **12** from the front of the housing **10**, as shown in FIG. **1**, and the inner housing **11** is inserted into the hood **121**. When the housings **10** and **120** are fit together, the front end of the hood **121** is disposed radially outward from the flange **20**, and the locking arm **49** elastically locks the lock of the mating housing **120** to hold the housings **10** and **120** together. At this time, the sealing member **80** is compressed between the inner surface of the hood **121** and the outer surface of the inner housing **11** to seal the gap between the housings **10** and **120**.

The elastic member **90** is compressed between the first contact surface **21** of the flange **20** and the second contact surface **57** of the body **37** of the outer housing **12** when the housings **10** and **120** are fit normally together. At this time, the elastic member **90** elongates radially outward. However, the protrusion **58**A of the hold-down part **58** contacts the outer end of the elastic member **90** to limit outward elongation. The limiting of the outward elongation of the elastic member **90** suppresses a decrease in the elastic restoring force of the elastic member **90**. As a result, a proper separation force acts between the housings **10** and **120**. Thus the reliability of the shake prevention performance of the elastic member **90** is ensured. The hold-down part **58** contacts the central portion of the elastic member **90** in its width direction. Thus, the elastic member **90** will not deform elastically at one side in its width direction.

The connector disclosed in Japanese Patent Application Laid-Open No. 2009-4111 has an elastic member that elongates outward in a direction orthogonal to the fit-on direction when the elastic member is compressed. Thus, there is a fear that the elastic restoring force of the elastic member decreases. The connector is provided with an escape prevention construction to suppress outward elongation of the elastic member. However, the connector is large due to the addition of the escape prevention construction and cannot comply with a demand for miniaturization.

On the other hand, the compressed elastic member **90** of the subject invention contacts the hold-down part **58** to restrain outward elongation of the elastic member **90**. Thus, the elastic restoring force of the elastic member **90** does not decrease and the reliability of shake prevention performance is enhanced. Further, the hold-down part **58** radially overlaps the locking arm **49** and hence does not enlarge the connector.

Further the locking arm **49** has two legs **50** at the central portion of the housing **10** in its width direction, and the hold-down part **58** is disposed between the legs **50** arranged in the width direction of the housing **10** in a front view. Thus the elongation of the elastic member **90** is suppressed in a favorable balance at the central portion of the housing **10** in its width direction. Therefore, the reliability of the shake prevention performance of the elastic member **90** is enhanced.

Furthermore the hold-down part **58** is formed on the outer housing **12** which is a part of the housing **10**. Hence, construction of a molding die is simpler than if the hold-down part **58** is formed inside the entire housing **10**.

If the inner housing **11** had concavities of different sectional configurations and the outer housing **12** had convexities of different sectional configurations corresponding to the sectional configurations of the concavities, the concavities discriminate the configurations of the convexities, and the convexities discriminate those of the convexities. Thus, it is

possible to detect the fit-on between the inner and outer housings **11** and **12** (referred to hereinafter as configuration detection). In addition by locating the convexities and the concavities at positions where the convexities and the concavities do not correspond to each other when the inner and outer housings **11** and **12** are erroneously fit together, it is possible to detect the fit-on between the inner and outer housings **11** and **12** (referred to hereinafter as position detection).

But in the case of the configuration detection, when the differences in shapes of the convexities and the concavities are very small, there is a fear that the convexity is inserted into the concavity with the convexity plastically deforming and fit-in may proceed even though the convexity cannot fit in the concavity. In the case of the position detection, when there is a restriction in the configuration of the inner and outer housings **11** and **12**, it is difficult to determine the forming position of each convexity and concavity. Thus this case has a problem that the degree of freedom in design is low. In the field of the connector, the above-described situation also applies to fit-on of members other than that of the inner and outer housings **11** and **12**.

On the other hand, in the subject invention, the outer housing **12** has convexities **43** of different extended lengths in the fit-on direction, and the inner housing **11** has concavities **19** with depths corresponding to the extended lengths of the convexities **43**. Thus when the convexities **43** are inserted into the concavities **19** to a normal depth, a normal fit-on state between the inner and outer housings **11** and **12** is detected. When the convexities **43** are not inserted into the concavities **19** to a normal depth, an abnormal fit-on state between the inner and outer housings **11** and **12** is detected. Therefore, detection means other than the prior art configuration detection means and the position detection means are provided to prevent the inner and outer housings **11** and **12** from being fit together erroneously.

The inner housing **11** has the two side by side tubular towers **17** and the concavity **19** is formed between the towers **17**. Thus, the dead space between the adjacent towers **17** is utilized and the connector has excellent space efficiency.

The upper convexity **43**A is sectionally triangular with straight opposite sides **45** each having an open angle corresponding to the upper concavity **19**A. Thus, it is possible to avoid the upper convexity **43**A from being scraped off by interference of the upper convexity **43**A with the lower concavity **19**B during an erroneous fit-on.

According to the invention, the forward surface of the main locking concavity **64** in the direction in which the retainer **60** is drawn out has the first slope **67** formed on the forward surface thereof and the first slope **67** is inclined along the direction in which the retainer **60** is drawn out. The forward surface of the locking projection **29** in the direction in which retainer **60** is drawn out has the second slope **35** that extends substantially along the direction of the first slope **67** at the main locking position. Therefore, the first slope **67** and the second slope **35** slide on each other when returning the retainer **60** from the main locking position to the temporary locking position and the retainer **60** can be returned smoothly to the temporary locking position.

The first locking surface **69** is formed on the forward surface temporary locking concavity **65** in the direction in which the retainer **60** is drawn out and is substantially orthogonal to the direction in which retainer **60** is drawn out. The locking projection **29** has the second locking surface **33** disposed substantially along the direction of the first locking surface **69** at the temporary locking position. Therefore, the first and second locking surfaces **69** and **33** are locked tightly together against the removal direction of the retainer **60** as the retainer **60** advances to the temporary locking position. Thus, the retainer **60** will not separate from the housing **10**. In this case, the second slope **35** and the second locking surface **33** are formed together on the locking projection **29**. Thus, the housing has a simple construction as compared with a construction in which the second slope **35** and the second locking surface **33** are formed at different portions.

The second slope **35** on the locking projection **29** is disposed at both sides of the second locking surface **33**. Thus, the retainer **60** has a favorable balance in its movement posture when the first slope **67** and the second slope **35** slide on each other.

The escape **70** is formed on the retainer **60** and extends in the movement direction of the retainer **60** between the main locking concavity **64** and the temporary locking concavity **65**. The first lock **30** of the locking projection **29** penetrates the escape hole **70** during movement of the retainer **60**. Therefore the first lock **30** does not interfere with the first slope **67** of the main locking concavity **64** and thus the retainer **60** moves smoothly. In addition, because this construction is capable of securing a large locking area of the second locking surface of the first lock **30**, the construction reliably prevents the removal of the retainer **60** from the housing.

The invention is not limited to the embodiment described above with reference to the drawings. For example, the following embodiments are also included in the technical scope of the present invention.

In addition to the upper convexity, the lower convexity may be triangular in section.

The temporary locking concavity and the main locking concavity may be formed on the housing, and the locking projection may be formed on the retainer.

The escape hole may be bottomed.

The first through sixth slopes may be curved.

The hold-down part may be formed on the inner housing.

Plurality hold-down parts may be formed in the circumferential direction.

The hold-down part may be formed over the entire circumference.

It is possible to form not less than three hold-down parts and opposed tubular portions by arranging them side by side and a plurality of concavities and convexities.

In mounting the cover on the housing, it is possible to form a concavity on one of the housing and the cover and the convexity on the other of the housing and the cover.

What is claimed is:

1. A connector comprising:

a housing which can be fitted on a mating housing and into which terminal fittings are inserted;

a retainer mounted on the housing movably between a temporary locking position and a main locking position, the retainer allowing the terminal fittings to be inserted into the housing at the temporary locking position, and preventing the terminal fittings from being drawn out of the housing at the main locking position;

a main locking concavity formed on one of said housing and said retainer and having a first slope formed on a forward surface thereof in a direction in which said retainer is drawn out, the first slope being inclined along the direction in which the retainer is drawn out;

a temporary locking concavity formed on one of said housing and said retainer and having a first locking surface formed on a forward surface thereof in the direction in which said retainer is drawn out, the first locking surface being substantially orthogonal to the direction in which the retainer is drawn out;

a locking projection (**29**) formed on the other of said housing and said retainer, the locking projection being fit elastically in the temporary locking concavity at the temporary locking position for holding the retainer at the temporary locking position, and elastically fit in the main locking concavity at the main locking position for holding the retainer at the main locking position;

a second slope formed on a forward surface of the locking projection in the direction in which the retainer is drawn out, the second slope being disposed on the first slope substantially along a surface direction of said first slope at the main locking position; and

a second locking surface formed on the forward surface of said locking projection in said direction in which said retainer is drawn out, the second locking surface being disposed substantially along a surface direction of said first locking surface at said temporary locking position.

2. The connector of claim **1**, wherein said second slope of said locking projection is disposed at both sides of said second locking surface.

3. The connector of claim **2**, wherein an escape hole is formed on one of the housing and the retainer at a position between the main locking concavity and the temporary locking concavity, the escape hole extending in a direction in which the retainer moves, the second locking surface of the locking projection advancing in the escape hole during movement of the retainer.

4. The connector of claim **1**, wherein the housing has a first and second members fit together; concavities formed on said first member and extending in a fit-on direction, and convexities formed on said second member and extending in said fit-on direction, the convexities being inserted respectively into the concavities when the first and second members are fit together, the convexities having different extended lengths in the fit-on direction, and said concavities having different extended lengths corresponding to the lengths of the respective convexities.

5. The connector of claim **4**, wherein said first member has two tubular towers disposed side by side, said concavities being formed between said towers.

6. The connector of claim **5**, wherein said concavities are partitioned by circular arc surfaces of the towers and have sharp apices in correspondence to a position where the circular arc surfaces join each other; said convexities including a forward convexity that interferes with said concavity in an erroneous fit-on operation is sectionally triangular with straight opposite sides each having an open angle corresponding to said concavity.

7. The connector of claim **4**, wherein the first and second members of the housing are defined by a block-shaped inner housing into which terminal fittings are inserted and a tubular outer housing surrounding a periphery of the inner housing.

8. The connector of claim **1**, wherein the housing has a locking arm holding a mating housing in a separation prevention state when said housing and said mating housing are fit together;

an annular elastic member mounted on the housing is compressed in a fit-on direction when the housings are fit together to prevent the housings from shaking;

the housing having a hold-down part contacts the elastic member placed in a compressed state thereof substantially orthogonal to the fit-on direction to suppress elongation of the elastic member in the radial direction; and

the hold-down part overlaps the locking arm in the radial direction.

9. The connector of claim **8**, wherein the locking arm has two legs at a central portion of said housing in a width direction thereof; and said hold-down part being between the legs in a front view.

10. The connector of claim **8**, wherein the housing has a tubular outer housing and a block-shaped inner housing inserted into said outer housing and held thereby; and

said hold-down part being formed on said outer housing or said inner housing.

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